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Electrical World

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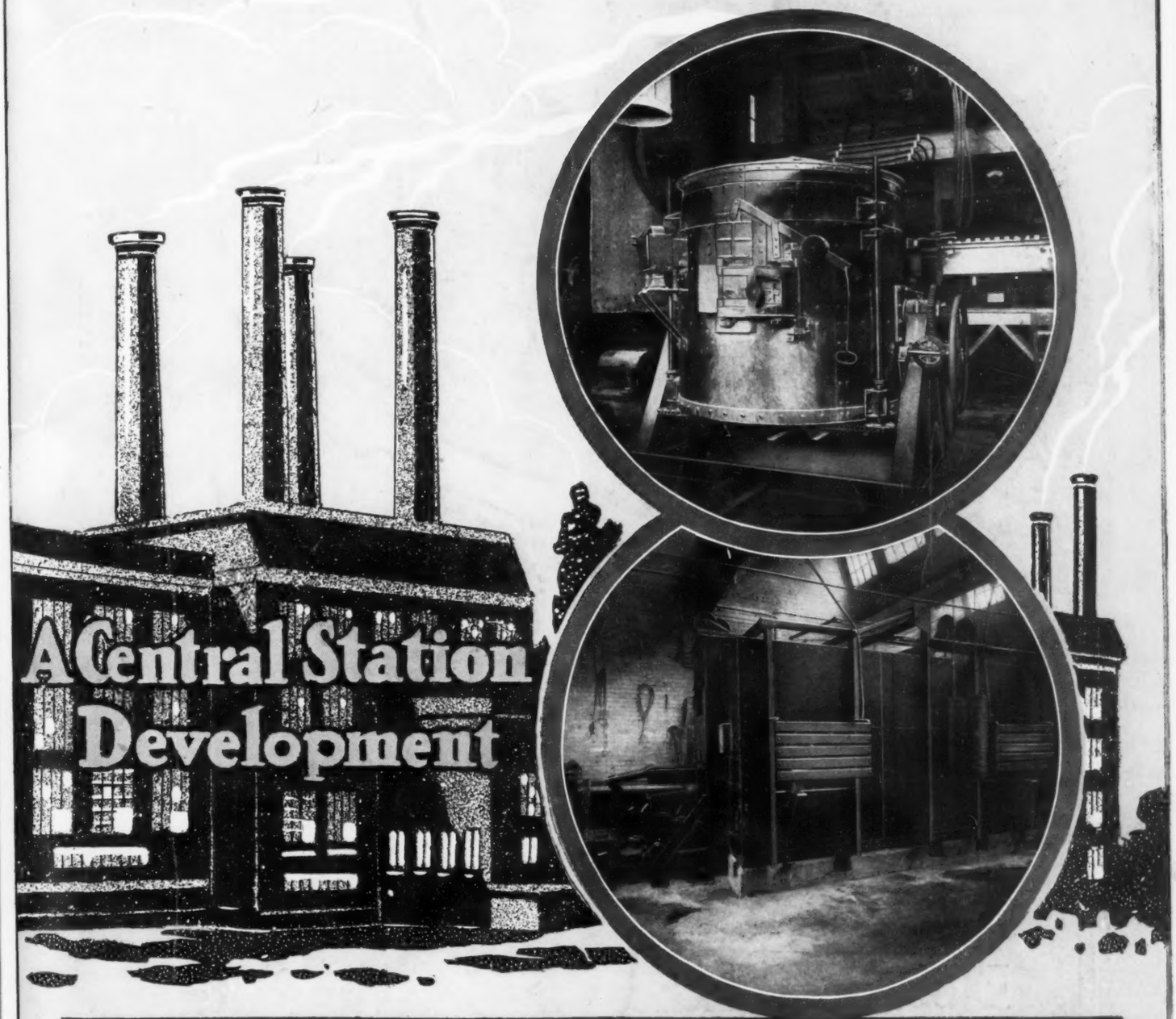

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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The Engineer's Place in the Scheme of Things

NOTEWORTHY among the events of the recent meeting of the American Institute of Electrical Engineers at Boston was the address of the president emeritus of Harvard University. The burden of eighty-four years has not dulled Dr. Eliot's keen intellect nor lessened his interest in contemporary affairs, and his own early scientific training lent to his words an additional weight of authority. In dwelling upon the engineer's need for both broad intellectual training and warm human sympathies the veteran educator occupied unattackable ground. Of all the professions, he said, engineering does most to increase the comfort of the people and facilitate the pursuit of happiness. One has only to contrast the mode of life in highly civilized countries to-day with that of the early nineteenth century, when modern engineering got its real start, to realize the truth of this assertion. To engineers, be they solitary inventors or the constructors, appliers and extenders who flock in the inventor's trail, not only the rich but the poor as well owe the far greater ease with which, as compared with their predecessors, they procure their daily warmth and light, hot and cold water, facilities for cleanliness, fire for cooking and means of refrigeration. To them men owe the greater rapidity and pleasure and the smaller cost of travel by land and water. To them are due pleasures and excitements our ancestors never dreamed of—the phonograph, the motion pictures, the pleasure car, the motorboat, the airplane. How much have the express trains, the swift ocean steamers, the telegraph and the telephone done to lessen the pain of separation from friends by providing means of swift communication and of prompt reunion when the need arises! And what a stimulus the human mind has gained from the daily spectacle of structures of many kinds, in stone and iron and concrete, on, above and under the earth's surface, huge often in size but with the grace that skillful adaptation of means to ends imparts, which are at once man's victory over nature and the monument to that victory!

Engineering, Dr. Eliot observed, used to be considered a materialistic profession, but he knew of none involving a greater use of the imagination. Here is a truth of which sight is sometimes lost. Lawyers are tied to statutes, physicians to the pharmacopœia, clergymen too often to their creeds, but no pent-up Utica contracts the vision of the engineer; the whole boundless universe is his. To the imagination of Watt and Stephenson, of Morse and Bell, of Langley and Wright, of Edison and Marconi the world is immensely the debtor. To the engineering imagination of yesterday it will soon owe the ability to talk across the ocean and to traverse it on wings. To-day other marvelous projects are taking shape in the engineering brain, and to-morrow will announce them to a freshly astonished but no longer incredulous world.

Dr. Eliot's criticism of some of the methods of instruction in our elementary and secondary schools, his insistence on university training, for the ordinary engineer as well as for the genius (who perhaps needs it less), and his views on the part that engineers should take in enlightening corporations and inspiring workmen toward harmony and common effort in turning imagination into achievement will appeal to a far wider audience than even the one he addressed. He himself, famed mainly as educator and publicist, discloses none the less an engineering mind of the finest type, practical, constructive, lucid, intent, seeking refuge, in the closing days of a long life, neither in the cynicism of disillusioned age nor in the rhapsodies of cloistered visions, but helpful, unselfish, philanthropic to the end—uniting in rare and fine proportion the material, from which no man can escape, with the spiritual, which no man should deny.

Up go the rates on telegraph messages, and the manner of their promulgation shows what novices other public utility managers are. The commissions and utility companies have always held out for performance and service first, but such sentiments find no lodgment in the office of the Postmaster-General. He dispatches service as Richard III did Henry VI, "Down, down to hell and say I sent thee thither!"

Isolated Plants and Economy

WE WONDER how far the general public has come to realize the very grave economic changes in power production which have occurred within the last few years. Undoubtedly it feels them, and engineers have come to grasp them fully. Yet, in spite of all this, there are hundreds, yes thousands, of isolated plants still operated at what must really be serious loss to their owners. With cheap labor and cheap coal the difference between the cost of power purchased and power generated may be comparatively small. As coal and labor go up the operating costs of a plant with a poor load factor rise at an appalling rate, and even when the load factor is fairly good the difference in economy between a big plant and a small one is formidable.

As things stand to-day the absolute cost of fuel has on the whole more than doubled and the cost of labor has risen in about the same degree. Moreover, the former shows no hopeful indications of dropping and the latter very plain symptoms of rising. A standard eight-hour day comes pretty nearly being an accomplished fact in general industry, and longer working

periods can usually be maintained only at a considerable wage increase. Whether this element in the cost of power is to be maintained permanently at the present high level may be open to question, but wages are not likely to come down without a reduction in the cost of living, and the latter waits on the former in an economic deadlock. The coal costs are likewise unlikely rapidly to be reduced.

The result of these changes on the isolated plant is nearly or quite to double the actual cost of energy per kilowatt-hour. In some instances it is increased even more, and the added cost of replacement and repairs at present is still another serious item for consideration. Meanwhile, although most central stations have been forced to adopt a coal clause, there is very little doubt that such increases of price as they have been obliged to make are far less than the added charges that overwhelm the producer of power on a small scale. It is therefore time for a very thorough overhauling of the whole question of costs by those who are operating independent plants and striking anew the balance sheet between power purchased and power produced.

The great increase in central-station loads from the realization of this situation is, of course, already obvious; but we doubt very much whether any considerable percentage of the isolated plants which would actually profit by changing to central-station service have even yet come over. The same forces that are building up great networks supplied from a few big stations, replacing plants locally active, make the economic condition of the small power producer conspicuously bad, so that he now would profit by shutting down, even if it were necessary to undertake a considerable transmission from an economic source in order to get his power. The day of most of the basement plants is pretty well passed, and if their owners would deliberately sit down and find out the costs that are piling up ahead of them, they would not long hesitate in making the change, once economically possible or plausible, now imperative.

Philosopher, economist and statesman that he was, Benjamin Franklin saw the advantages of daylight saving over a century and a quarter ago. Betraying his natural bent, he also figured out how much money might be saved, but alas! there is nothing to indicate that Franklin rose with the cock. The narrative published elsewhere would suggest quite the contrary.

Illumination Required for Industrial Operations

IN CONNECTION with the ever-present subject of industrial lighting we are glad to present the data promulgated by the New York Industrial Commission with respect to the minimum intensities of illumination required for a large number of specific cases. They follow rather closely the recommendations of the Illuminating Engineering Society, and while now presented in a tentative way, the values here given will be made mandatory July 1 unless the experience gained before that time renders changes desirable. The list has been prepared with special reference to conditions as they exist in the various operations of numerous industries. From place to place in a given establishment they will necessarily vary according to the particular operations being conducted. The list, however, is sufficiently general in scope and specific in detail to give the factory inspectors a very clear view of the conditions as they ought to exist.

In running over the table we are impressed with the fact that certainly in nearly every instance these values are real minima which should not be reduced, and, such being their nature, it is evident that a factor of safety must be allowed for the deterioration of the lamps and fixtures during usage. This allowance is specified as 25 per cent for the initial illumination in order to maintain the required values. In many instances we think that the minimum is too low, as, for example, in the finer operations of jewelry manufacture, in engraving and in exact inspection in various industries. We have not yet discovered any case in which the recommended intensity seems unnecessarily high for the requirements of really efficient work. This table should convey to inspectors valuable information to be applied in the course of their regular duties.

Not a few central stations during the war curtailed in their commercial departments so that now new departments must be built. This time a true foundation for permanency should be laid and departments so organized that they can be expanded or contracted to fit conditions without destroying their structure.

The Maintenance of Power Equipment

THE big industrial plant presents for the power engineer a series of intricate and troublesome problems. His original plant must be laid out with reference to the particular work to which it is to be applied, the general economics of the situation as it exists and the possibilities of passing beyond the initial stage to future growth and perhaps to the utilization of a general power supply. These are things which need something of the prophetic instinct, but besides these in the immediate present lies the problem of maximum continuous usefulness, which requires that all the elements of the plant from prime movers to motors shall be ready at all times to do their appointed work.

We were glad therefore to give last week a discussion of the maintenance of power equipment which we believe will be profitable to many of our readers. The study centers about the operations of one big typical plant in steel-mill practice, involving a capacity of 18,000 kw., serving the general purpose of a system scattered over 1200 acres. When one realizes that the electrical department numbers about 275 employees, the importance of thorough organization is self-evident. To this end a very complete system of keeping track of all the apparatus and its performance has been inaugurated under skilled foremen who have charge of certain particular phases of the work. Inasmuch as continuous operation is peculiarly necessary in this class of industrial work, every effort in planning the equipment and keeping it at top efficiency is systematically directed toward this end. The result of this complete study of the situation has been steadily to improve the operating conditions, to better the equipment in making extensions, and to keep the whole plant working toward higher industrial efficiency. The details given in our paper are well worth thorough study by those who are charged with the grave responsibility of keeping up large power systems, and not a few of the methods described will be found of very general application.

Accurate Timing in Electrical Tests

IN CONDUCTING short-time tests of electrical apparatus it sometimes happens that the precision of the apparatus under test exceeds that of the ordinary stop watch with which the test is made. In such a case, unless the observer is on his guard, the error he may assign to the apparatus may be mainly attributable to the unsuspected error of his timekeeper. This possibility is clearly presented in the article this week by Prof. F. A. Kartak. Two methods of obviating the difficulty are described, one involving an improved form of stop watch, the other a cycle counter converted into the equivalent of an accurate timekeeper through the intervention of a carefully adjusted tuning fork.

It is certain that electrically driven forks are coming into more generally recognized use. A tuning fork, properly constructed, is a wonderfully reliable timekeeper, and, unlike an ordinary pendulum, its frequency is nearly independent of its amplitude of vibration unless the amplitude is unusually large. The precision in time obtainable with tuning-fork control is easily of the third order, or one part in a thousand, and without much difficulty can be raised to the fourth order, or one part in ten thousand. In the stroboscopic fork, which is another well-known laboratory adjunct, the precision with which a steady speed of rotation can be measured is also of the third or fourth order.

The average cost of energy at the various army cantonments was 2.5 cents per kilowatt-hour. Most of the cantonments were located some little distance from nearby cities, necessitating rather long service extensions, but we presume some calumniator will arise and insist that there was profiteering in this charge.

The Muscle Shoals Nitrate Plants

ALMOST instructive and impressive view of the preparations made by the government for the fixation of nitrogen on a large scale is given in our columns this week by Messrs. E. R. Welles and C. T. Mitchell. Although the cessation of hostilities has put a temporary end to the need of nitrates for military purposes, their importance in agriculture is so great that, if the plants here described can be operated as economically as their projectors have thought, they may be of very large importance in time of peace.

The installation of both plants was a rush job of the severest character, in which the ordinary routine of design and construction had to be abandoned in favor of doing everything in the least possible time. It is greatly to the credit of the engineers that this was accomplished without being driven by necessity from sound lines of design. The power stations must be of high economy if they are to be useful in times of peace. The plants had to be erected and put in operation within a year, and to facilitate operations it was decided temporarily to take part of the power from the transmission system of the Alabama Power Company, which is capable of supplying about a third of the total output. The remainder is to come from the steam stations.

A notable fact in respect to them is that while on Jan. 1 of last year nothing but preliminary sketches had been made and none of the apparatus for the power plant purchased, eleven months later the cyanamide process had been started up with transmitted power, the first unit of the great turbine was practically ready for use and the two others under erection or ready for shipment, while the boiler plant was so far completed as to be ready when the turbine required steam. Whatever may be the ultimate fate of the plant under commercial stress in time of peace, its preparation for action in so short a time ranks as one of the big engineering feats of the war.

The power to fix rates is a fundamental regulatory function, overshadowing many managerial prerogatives in its influence on corporate welfare. Good management invites minimum interference from state commissions, but where prices and capitalization are subject to their jurisdiction it is fatuous to suppose that company administration is independent.

Maintaining the Efficiency of Hydroelectric Plants

THE changes of the last decade or so in the hydraulic efficiency of waterwheels have been of a somewhat startling character, although not very widely realized. The fact is that efficiencies, owing to more skillful design and installation, have risen something like 10 per cent when the plants are operated under reasonably favorable conditions. Besides this the general situation with respect to hydroelectric power has itself changed somewhat radically. While the earlier plants were oftentimes hunting for load, the later ones are wondering how load can be supplied without recourse to steam auxiliaries. In short, the time has come when to meet the growing demands of industry hydroelectric installations must be operated at high efficiency and must save water to the utmost, both by storage and by more skillful utilization. F. H. Rogers, hydraulic engineer for an extremely well-known builder of turbines, in the current issue brings very strikingly to notice the refinements which modern practice demands in a hydraulic plant. The matter which he specially considers is the maintenance of high efficiency.

The point of the matter is this, that while it is perfectly practicable to produce turbines of around 90 per cent useful efficiency, thus wringing out of the stream some 10 per cent more energy than used to be believed possible, it requires some reasonable degree of watchfulness to maintain continuous operation at the full rated efficiency. Of course, variations of efficiency due to load will always occur; but for any definite load increases in losses must be looked upon as a symptom of avoidable impairment of efficiency. Through water friction losses and leakage losses it is extremely easy to lose several per cent in the available power of the plant, which in these days may mean several per cent less salable energy or the corresponding amount of power produced from steam auxiliaries at high prices of fuel. The remedy for difficulties of this kind, as Mr. Rogers points out—and it is really a very simple one—involves keeping a close watch over the performance of the prime movers, knowing what the plant can do in first-class working trim.

In other words, the hydraulic plant should have the same kind of attention which is customarily given to the performance of a steam plant for the purpose of detecting and remedying any losses of efficiency. For this work indicating and recording gages are necessary, and therefore those which are installed for the initial test should be made permanent accessories of the plant.

Accurate Timing in Electrical Tests

Errors Resulting from Use of Ordinary Stop Watches—Tuning-Fork Timing Device Which Has Been Found Very Satisfactory in Practice Is Described and Illustrated

BY F. A. KARTAK
Director Standards Laboratory, University of Wisconsin

For general timing work, such as the timing of revolutions of meter elements, the timing of the rotors of electrical machines in deceleration tests, the determination of the rates of rise of currents in circuits of extremely long-time constants and the like, a device similar to the stop watch in its method of application but possessing greater accuracy, ruggedness and reliability is highly desirable. It is also essential that the device, or at least its indicating element, be portable. The construction and performance of such a device are considered in this article.

FOR accurate work in commercial electrical measurements[1] it is essential that short time intervals be accurately measured because longer time intervals, which reduce the objectionable errors, do not permit the speed necessary for commercial testing work. The accurate measurement of short time intervals, however, has presented a more difficult problem than though the time-keeping rate has been maintained with high precision. It is the purpose of the following discussion to emphasize the unreliability of the ordinary stop watch for this type of work and to describe two methods which have been developed for use at the standards laboratory of the University of Wisconsin to replace the stop watch in the measurement of time intervals.

Depending upon the nature of the testing work to be done, it may be necessary or more advantageous to employ a timing device which falls into one or the other of two classes: (1) Variable-interval timing devices; (2) fixed-interval timing devices. Devices of the first type measure time intervals (of any reasonable length) in seconds or hours and fractional parts. To this class belong stop watches and other similar pieces of apparatus. Devices of the second type measure or

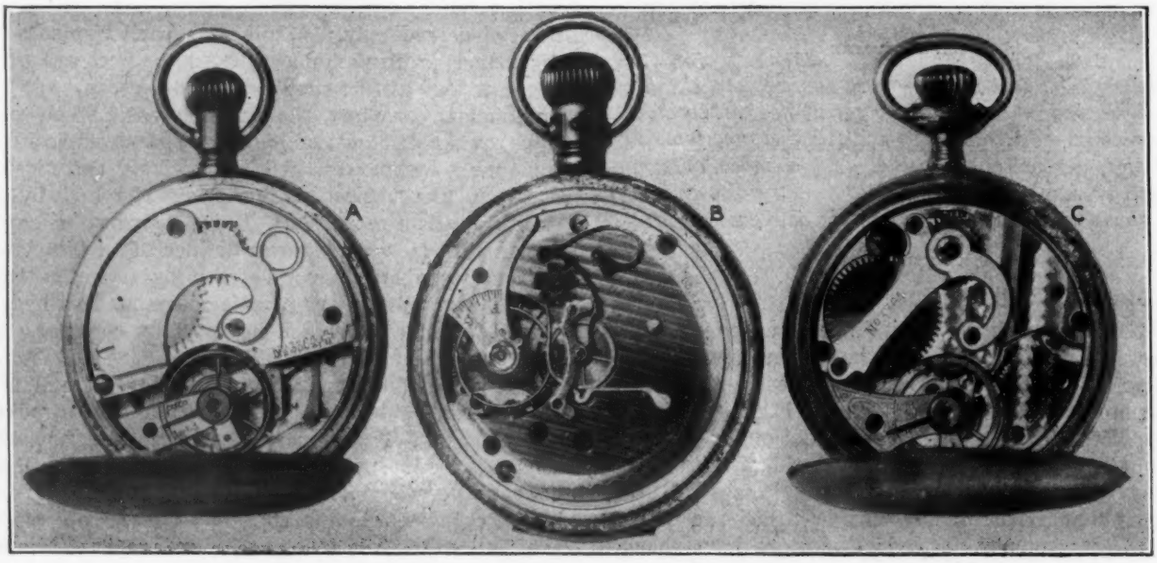


FIG. 1—THREE TYPES OF STOP WATCHES

A and *C* are stop-mechanism types, while *B* is a chronometer with a stop attachment. (See text for explanation of differences.)

measurement of long[2] intervals, since it has been found difficult to eliminate the starting and stopping errors in measuring devices (such as stop watches), even set off definite integral values of time in seconds or hours. As will be pointed out later, this type of device is most useful in the testing of portable standard watt-hour meters, but the variable-interval timing devices will be considered in this article.

The accuracy of the average stop watch in meter-testing work has in general been greatly overestimated. While a well-made watch may usually be regulated to hold a time-keeping rate which is accurate to at least one minute per week or approximately one-hundredth of 1 per cent, errors are introduced during the starting and stopping operations, which may amount to as much as one-half of 1 per cent or 1 per cent, or more, when an interval of not greater than thirty seconds[3] is used

[1] Since the unit of power (the watt) and the unit of time (the hour) both enter into the unit of energy (the watt-hour), it is important in the testing or calibrating of watt-hour meters that the errors in the measurement in both of these quantities be reduced to the smallest value possible. By using a high-grade indicating wattmeter of the precision dynamometer type which has been carefully calibrated by means of a potentiometer, the uncertainty in the power measurement may be reduced to approximately one-tenth of 1 per cent. The use of stop watches, however, for the measurement of the time element of the energy quantity, which has in most cases heretofore been the practice, has introduced, under normal conditions of use, a much greater uncertainty into the measurement of energy.

[2] Inexpensive pendulum clocks may be had which with practically no attention will keep time to within forty seconds per week, and the requirements of the railroad companies covering the accuracy of the watches of their employees demand that the change in rate shall not be greater than twenty seconds per week. These changes in rate amount to approximately seven-thousandths of 1 per cent and three-thousandths of 1 per cent respectively since there are 604,800 seconds in one week.

[3] The minimum time interval permitted by the Railroad Commission of Wisconsin in connection with the testing of electrical meters.

in testing. In addition to this, it has been observed that many stop watches, while checking out accurately at the end of a complete revolution of the second hand, do not indicate correctly at the fractional parts of the revolution, losing in some cases as much as one-half second during the first thirty seconds and regaining this amount during the remainder of the minute, or vice versa

According to the manner of construction, stop watches may be classed under one of two general headings:

Chronometers with Stop Attachments.—Those in which a chronometer or watch movement operates continuously and in which the depression of the key engages or disengages the stop attachment with the chronometer movement.

Stop-Mechanism Watches.—Those in which the entire mechanism is started and stopped by the depression of the key.

Watches of the chronometer type (see *B*, Fig. 1) are perhaps more often used in important meter-testing work since the time-keeping rate of the movement is more easily checked. In order not to interfere with the time-keeping rate, the stop mechanism is engaged during only approximately the last 10 deg. of the balance-wheel stroke, which covers about 250 deg. Thus an error in amount equal to the time of stroke, or the period of the balance wheel, may be introduced at starting and again at stopping, since the indicating hand does not move or "pick up" until during the last 10 deg. of the 250-deg. stroke. Since nearly all chronometer-watch balance wheels have a period of 0.2 second, the error introduced into a thirty-second interval may be as much as 1.3 per cent even though the time-keeping rate be correct.

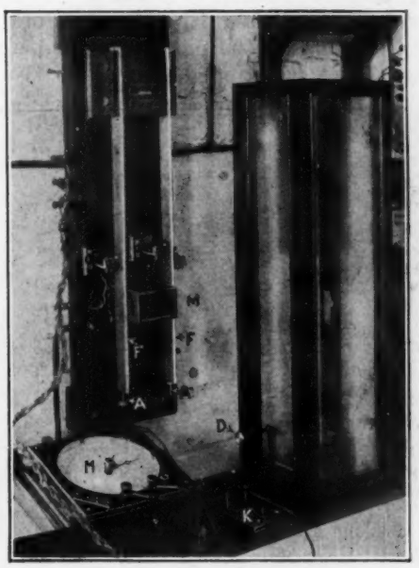


FIG. 2—TUNING-FORK TIMING DEVICE

The device consists essentially of a heavy iron base casting, in the head block of which are mounted the two steel fork legs *f*, actuated by magnet *m*. These legs are rigidly clamped by means of cap screws, the fork legs being adjustable in the clamping slots because of slotted holes in the fork blades. Pressure of *d* starts the forks vibrating. Final adjustment for rate of vibration is obtained by means of counter weights *a* at the ends of the fork legs. *M* is a timing device. The fork was designed to give twenty full cycles or forty strokes per second. The free portions of the fork legs are rectangular in section and are approximately 18 in. (45 cm.) long, the length being calculated from Raleigh's formula: $f = 84{,}600\ t/(l)^2$, where *f* is the frequency of vibration in cycles or periods per second, *t* is the thickness of rectangular fork leg in the plane of vibration in centimeters, *l* is the free length of fork leg in centimeters. The section of the fork leg or rod used was $\frac{3}{16}$ in. by 1 in. (4.8 mm. by 2.54 cm.).

Watches of the stop-mechanism type, which generally include those of least expensive construction, are also usually constructed with a balance wheel beating 0.2 second. In these watches (one of which is shown at *A* in Fig. 1) the possible errors introduced are the same as those discussed above, since the stop hand is actuated only during a small portion of the balance-wheel oscillation.

To reduce these errors a watch of the stop-mechanism type, such as is shown at *C* in Fig. 1, has recently been placed on the market. The balance wheel in this watch has been made much lighter and the hair spring has been made stiffer and has but two or three convolutions instead of ten or twelve, with the result that the balance wheel makes fifty beats or oscillations per second instead of five. One complete revolution of the hand over the dial takes place in six seconds instead of in sixty seconds. This cuts down the starting and stopping uncertainties from 0.4 second to 0.04 second. Based upon a thirty-second test interval, the uncertainty in the measurement, assuming an accurate time-keeping rate, is thus 0.13 per cent.

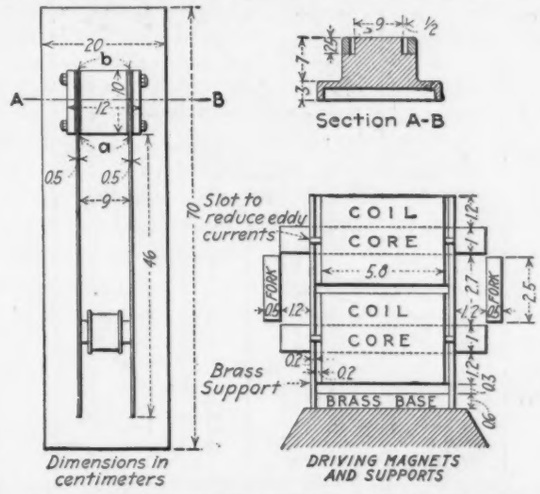


FIG. 3—CONSTRUCTION DETAILS OF TIMING DEVICE

While this 0.02-second type of watch has not been used at the standards laboratory of the University of Wisconsin for a time sufficiently long to warrant any comments on its ruggedness for field-testing work, past experience at the laboratory has shown that with stop watches of the ordinary kind (both stop-mechanism and chronometer types) great difficulty is found in maintaining them in a satisfactory condition. The mechanism is too delicate to stand the service of field-testing work in a satisfactory manner for any great length of time unless used and handled with great care. Even with the best of care, such watches should be regularly checked at frequent intervals to make certain that no change in operating characteristics has taken place.

TUNING-FORK TIMING DEVICE

Because of the uncertainty and the unreliability involved in the use of stop watches for the accurate measurement of short time intervals (from thirty to sixty seconds) it has been desirable to investigate the possibilities of developing more satisfactory methods of timing to be used in connection with the testing of portable standard watt-hour meters. A number of such methods,[4] having particular application to special prob-

[4] Thompson, ELECTRICAL WORLD, Vol. 61, p. 296, Feb. 1, 1913; Knopp, ELECTRICAL WORLD, Vol. 62, p. 242, Aug. 2, 1913; "Electrical Meterman's Handbook," 1915 edition, p. 273.

lems in meter testing have already been proposed and used, but none of these has completely met the requirements of the testing work of the standards laboratory of the University[5] of Wisconsin.

Through the courtesy of the United States Bureau of Standards,[6] permission was obtained to duplicate a tuning-fork timing device which was originally designed and put into operation at the Bureau of Standards laboratories. To the writer's knowledge a description of this device has not been published by the bureau, but since a number of modifications of the original design have been made by the writer to increase its accuracy and reliability, it is thought desirable to make public at this time a description both of the fork and of the modifications which have been made.

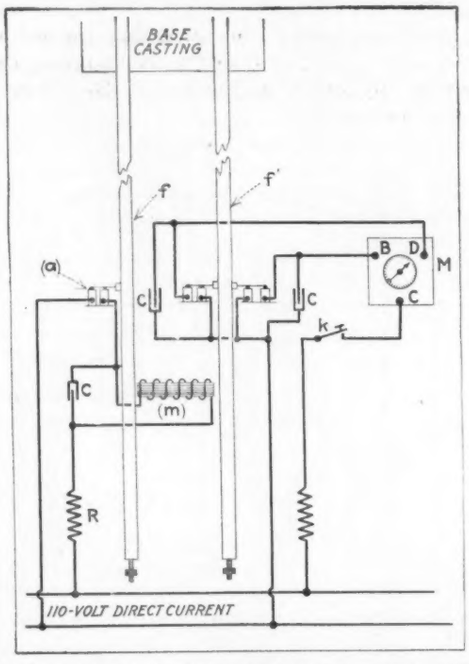


FIG. 4—ELECTRICAL CONNECTIONS OF TIMING DEVICE

The left fork leg, *f*, which is known as the driving or actuating leg, makes electrical connection at nearly the extreme of its left stroke by means of the mercury contact shown at *a*. An enlarged view of this contact is shown in Fig. 5. When the circuit is closed at *a*, the current, which is limited in value by the resistance *r* to about 0.03 amp., flows through the magnet *m*, thus causing both fork legs (which form part of the magnetic circuit) to be drawn together until the contact at *a* is broken. (This action is similar to that of the contact of a vibrating-type ignition coil). If the adjustments of the fork legs and of the contact at *a* are properly made, the fork legs will vibrate at their free or natural periods. The right fork leg *f'*, which is known as the operating leg, makes contact at each end of its stroke, thus causing current to flow from the positive or plus busbar to one or the other contact at either end of the stroke, through the counting device at *M*, and back through the key *k* to the negative busbar or line.

As a timing device which is unchangeable in its operating characteristics, the tuning fork has not had the prominence which it deserves. It is probably not generally known that a fork of this kind when properly constructed can be made to vibrate accurately at its natural period or number of strokes per second regardless of variations in the driving force, and that within reasonable limits the rate of vibration is independent of the amplitude of vibrations of the fork legs. Forks of this kind are only slightly affected by temperature changes, the change in rate of vibration with change in room temperature being only 0.009 to 0.013 per cent per degree Centigrade.

Fork Construction.—The tuning-fork timing device as constructed and used at the standards laboratory is shown in Fig. 2. Difficulty was at first experienced because of the high stresses due to the operation of the fork causing the cast-iron head to fail at point *a* (Fig. 3), thus altering the clamping and the effective free length of the fork and causing a change in the period of vibration of the fork leg. This was remedied by milling out the clamping slot and placing hardened steel faces in the clamping jaws at *b*. In order to eliminate any change in rate due to "fatiguing" of the steel of the fork blades themselves, an "anti-fatigue" alloy steel known as "electro - chrome - silico - manganese spring steel" and having the following average analysis (in percentage) was used: Carbon, 0.43; silicon, 0.65; manganese, 0.85; chromium, 0.90; phosphorus, 0.018, and sulphur, 0.015. The desirability of using an "anti-fatigue" steel is indicated by the fact that affer about eight months of steady use the change in rate of the fork cannot be detected by the method of test used, which permits an accuracy of the order of 0.03 per cent.

Operation.—The fork, after being started manually by depressing the plunger shown at *d* (Fig. 2), is caused to operate electrically from a 110-volt direct-current supply circuit and continues to vibrate so long as voltage remains on the circuit. (Read explanation under Fig. 4.) A counting device (Figs. 6 and 7 and *M*, Figs. 3 and 4), whose construction is explained later, registers the current impulse sent through it at the end of each stroke of the fork leg *f'*, thus registering time in steps of 0.025 second each. By utilizing the key *k* as one would the depression key of a stop watch, a time interval may be measured in steps of 0.025 second.

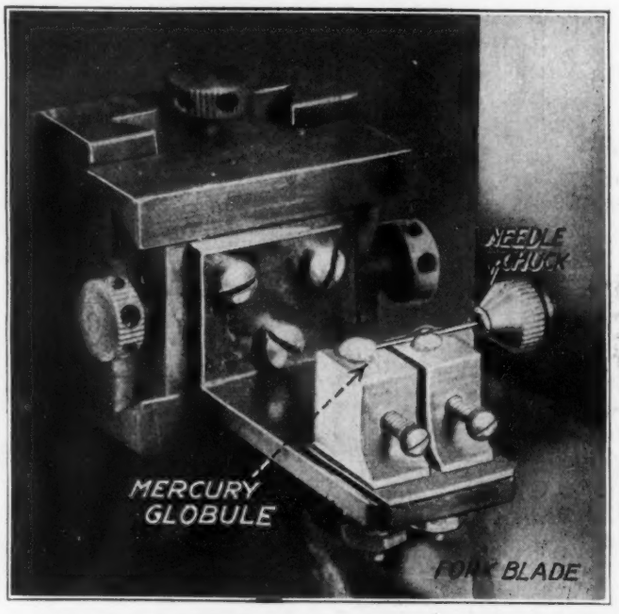


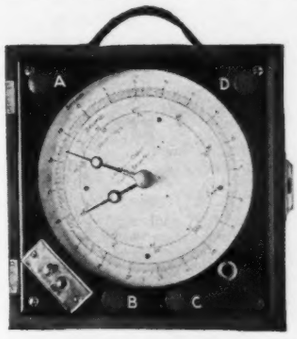
FIG. 5—NEARBY VIEW OF CONTACT-MAKING DEVICE

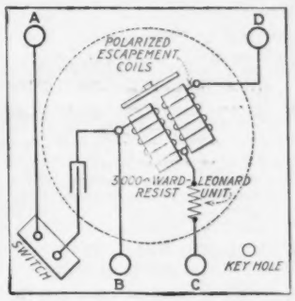
The contacts consist of steel needles riding in or through one mercury globule and pricking or contacting with another, both mercury globules being mounted on insulated steel blocks into which machine screws are threaded to permit the adjustment of the height and size of the globules. The needle is fastened to the fork leg by means of an insulated needle chuck, the needles thus being easily replaceable. The bracket supporting the mercury globules is adjustable both horizontally and vertically in guides mounted on the base panel.

[5]This laboratory, which is maintained jointly by the University of Wisconsin and the Railroad Commission of Wisconsin, undertakes electrical testing and investigational work of different kinds for public utilities, industries and individuals and is regularly testing and calibrating portable standard watt-hour meters for many of the public utilities of the state. This work, together with special investigations in meter testing which are being conducted from time to time, has long indicated the need for the types of timing devices mentioned in this article.

[6]It is desired to give full credit to the Bureau of Standards for the original suggestion and to thank Dr. P. G. Agnew of the bureau in particular for his kindness in furnishing a copy of the original drawings and specifications.

Contacts.—The mercury type of contact (Fig. 5) which was employed in this timing device was devised by the writer to eliminate the use of spring or metallic contacts, which (no matter how lightly made) react mechanically on the fork proper, causing a change or





FIGS. 6 AND 7—COUNTING DEVICE AND INTERNAL CONNECTIONS

With the connections to the binding posts *B*, *C* and *D* made as shown in Fig. 4, a current at one stroke of the fork passing through the meter binding posts from *B* to *C* causes the armature of the polarized magnet to be turned in one direction, and, at the end of the reverse stroke of the fork, a current passing through the meter binding posts, *D* to *C*, causes the armature to be turned in the reverse direction.

variation in the natural period of the fork. This mercury contact is noiseless as well, whereas it was necessary to operate the fork originally equipped with mechanical contacts in a sound-proof case.

Meter or Counter.—The meter or counting device used at the standard laboratory is a Holtzer-Cabot cycle counter, equipped with special connections for this type of service and provided with a special dial which reads directly in seconds. (See Figs. 6 and 7.) This instrument consists essentially of a high-grade clock mechanism in which the usual balance wheel and hair spring have been replaced by the moving element of a polarized telephone ringer in such a manner that this moving element actuates the escapement of the clock shown on the left-hand side of Fig. 8. The action of the polarized relay taking place at the rate of forty movements per second releases the escapement of the clock at the

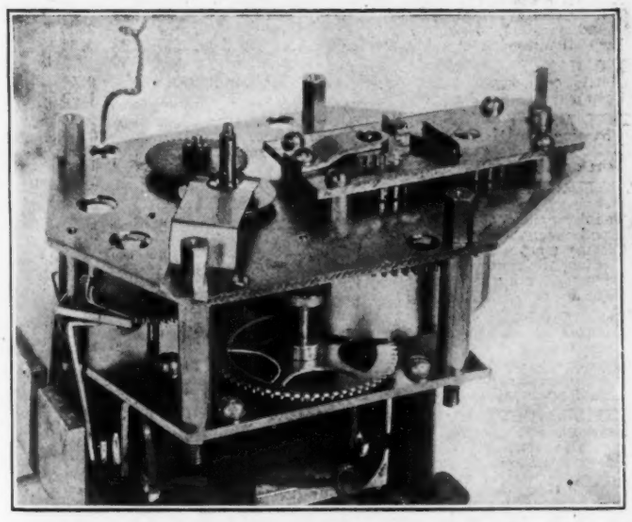


FIG. 8—CLOCK ESCAPEMENT ACTUATED BY POLARIZED RELAY AT LEFT

rate of forty beats per second and, with the clock hands properly geared to the movement, causes a corresponding indication over the dial to take place.

Temperature Coefficient.—The temperature coefficient of the fork as determined over a range of room temperature of 14.5 deg. C. to 42.5 deg. C. was found to be 0.011 per cent per degree. The temperature coefficient curve which shows the fork to be compensated for correct operation at 22 deg. C. is shown in Fig. 9.

Adaptability.—The fork described is permanently mounted on the brick wall of the standards laboratory. Its utility has been increased by providing a three-conductor cable connecting the fork and the counting device of sufficient length to permit the counting device to be used at any point in the room. By connecting this three-conductor cable to the switchboard circuits the counting device may be used in any part of the laboratory building.

For important meter-testing work at different substations or other meter installations a fork of this kind placed in the meter shop or laboratory of a central station might be connected to a counting device at any substation by means of a pair of wires with a ground return for the third conductor. A pair of wires either overhead or in a telephone cable would answer all re-

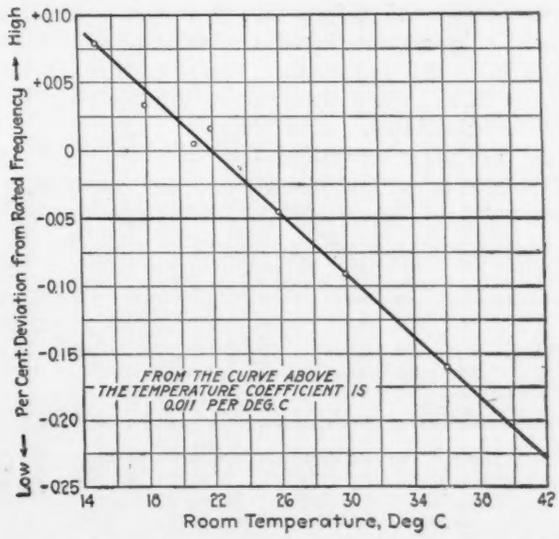


FIG. 9—TEMPERATURE COEFFICIENT CURVE FOR TUNING FORK TIMING DEVICE

quirements when using a ground return (if the necessary permission were obtained for the use of the wires from the telephone company), since the operating current of the counter is of the order of 0.02 amp.

While it is quite possible that a fork could be constructed which would accurately beat 0.01 second instead of 0.025 second, this increase in frequency would not be warranted in ordinary meter-testing work, since the personal errors in closing and opening the key at the beginning and end of the time interval are greater than the error due to frequency of the fork. The possible error in the measurement of time intervals due to the frequency of the fork would be 0.025 second at the closing of the key and again 0.025 second at the opening, or a total of 0.05 second. Tests at the standards laboratory have indicated that the usual error to be expected due to personal uncertainty in closing and opening the key amounts to about 0.2 second. With this uncertainty there would be but little gain in accuracy by increasing the beat of the fork from 0.025 second to 0.01 second, especially with the uncertainty introduced through the temperature coefficient when the room temperature cannot be closely maintained.

A discussion regarding fixed-interval timing devices will be printed in a later issue.

MINIMUM INTENSITIES FOR DETAILED OPERATIONS

Adopted by New York Industrial Commission to Take Effect July 1, 1919—For Guidance of Factory Owners and Managers

DATA on minimum and recommended intensities of illumination for general purposes have been published by the Illuminating Engineering Society and incorporated with little change in several industrial codes, but until now very little information has been available on requirements for particular operations. While not enough study has been given to specific cases to justify any hard and fast specifications for illumination intensities, the following data will give factory electrical engineers an idea of what the New York Industrial Commission considers fair values at the present time.

The data are tentative but will be made mandatory July 1 unless the experiences which have been reported or will be reported before that date justify changes. While the figures are based on tests in well-lighted installations, the commission suggests that factory engineers make tests to determine whether other values should be substituted.

There are some operations for which it is not advisable to specify any intensities. For instance, in certain parts of the process of glass manufacture it

MINIMUM INTENSITIES FOR DETAILED INDUSTRIAL OPERATION AND PROCESSES

	Minimum Foot-Candles at the Work
BAKERIES:	
Mixing and baking operations	1.00
BOILER ROOMS:	
Boiler rooms (general)	0.25
Pumps, condensers and apparatus	1.00
BREWING:	
Brewhouse (general), cleaning, malt mills, beer kettles, mash-tubs, rice cookers, beer-cooling coils, ferment room, stock room, filter room	0.50
Beer-keg washing, cooperage, racking or keg filling, automatic bottle-filling machine	1.00
CANDY MANUFACTURING:	
Mixing, cooking, hand dipping, machine dipping, cutting, cream beating, cooling, wrapping, packing, weighing	1.00
Machine operations	2.00
CHEMICAL MANUFACTURING:	
Furnaces, roasters, stills, precipitation, crushing, grinding, crystallizing, mixing tanks, evaporating, filtering	0.50
Extractors, compounding	1.00
CIGARS AND CIGARETTES:	
Stripping, cigarette packing (hand and machine)	1.00
Hand rolling, banders (hand), banding machines (cigarettes)	2.00
Automatic cigarette machines, paper-punch machines, cork-tipping machines, cylinder dressing machines (for tobacco)	1.00
DAIRY PRODUCTS:	
Cooler rooms, washing machines, pasteurizing apparatus, cream separators, ice cream freezers, churns, clarifiers	0.50
Bottle filling, bottle cappers, butter worker, butter printing, ice crushers	1.00
Packing and shipping	1.00
ELECTRIC CABLE MANUFACTURING:	
Flexible conduit and armor-cable machines	1.00
ENGINE ROOMS:	
At machines and engines	1.00
Switchboards and transformers	2.00
FERTILIZER MANUFACTURING:	
Cookers, pressers, fertilizer dryers, fertilizer mills	0.50
FOUNDRIES:	
Rough molding, tumbling barrels, charging floors, cleaning at cupola	0.50
Fine molding, grinding, machine molding	1.00
Coremaking	2.00
GLASS INDUSTRIES:	
Furnaces, annealing ovens, glass blowing	0.50
Mixing room	0.50
Grinding	1.00
Polishing	2.00
Etching	3.00
Cutting	5.00
GRINDING, BUFFING AND POLISHING:	
Rough work	1.00
Medium work	2.00
Fine work	3.00
ICE MAKING:	
Ammonia valves, tank floor, compressed-air hoist, compressors, dipping tanks, at run to storage, ammonia pump	0.50
JEWELRY:	
Gold and silver polishing, buffing, burnishing, punch-presses, clock assembling and repairing	5.00
Engraving, stone setting, modeling, saw piercing, jeweling, designing	5.00
LAUNDRIES:	
Washing machines, hydro extractors, starching	0.50
Sorting, marking and folding	1.00
Hand ironing	1.00
LEATHER GLOVES:	
Cutting	3.00
Sewing and stitching (machine or hand), examining, finishing	5.00
MACHINE SHOPS:	
Rough bench work, machine work, assembling	1.00
Medium bench work, machine work, assembling	2.00
Fine bench work, machine work, assembling	3.00
MEAT PACKING:	
Slaughtering, casing machine, casing department, beef coolers, packing, extractors, sausage-casing machines, dressing, post-mortem inspection, offal work, scalding vats, automatic dehairing machine, cleaning and cutting, grinding, casing, cooking	2.00
MILLING AND GRAIN PRODUCTS:	
Dust-collecting apparatus, grain elevators, general operations in workrooms	0.50
Separator, scouring, grinding, bolting, bagging, packing, all automatic machines	1.00
PAINT MANUFACTURING:	
Color-drying rooms	0.50
Compounding room, mixers (pony, liquid, cyclone), grinding mills, striking vats, boiling tubs, drying pans, putty chaser, can filling, can labeling, can soldering	1.00
PAPER-BOX MANUFACTURING:	
Power paper-cutting machines, slitting machines, scoring machines, automatic machines, stripping, top labeling machines, bench work (hand)	1.00
Corner staying machines, corner cutters	2.00
PAPER AND PULP MILLS:	
Wood grinders, acid plant, barkers, digesters	0.50
Paper machines, calender rolls, winders, beaters, wet press, screening	1.00
PEARL-BUTTON MANUFACTURING:	
Grading machines, wet and dry polishing	0.50
Grinding machines, cutting blanks and shells, carding buttons, hand turning, automatic machines	1.00
Sorting of waste, sorting for thickness	2.00
Grading for color and defects	2.00
PRINTING INDUSTRY:	
Metal pots	0.50
Stereotype casting	0.50
Job printing presses, cylinder presses, paper-ruling machines	1.00
Lithographing, electrotyping, trimming saws	2.00
Linotype and monotype machines, hand type-setting, proofreading	3.00
Engraving	5.00
RUBBER MANUFACTURING:	
Vulcanizing	0.50
Compounding scales, tubing machines, rubber-spreading machines, starching machines, cloth-printing machines, acid-curing room, churn room	1.00
Grinding mills, calenders, washing machine	1.00
Pressing forms	2.00
SHOE MANUFACTURING:	
Buffing, cutting, channeling soles, lasting, welting, trimming uppers, miscellaneous bench and machine work, stitching (hand and machine), turning	2.00
Inspection, treeing, cleaning, finishing	5.00
SOAP MANUFACTURING:	
Kettle house, dryer, mixers, soft-soap vats, blotter, framing	0.50
Soap press, soap mills	1.00
STEEL MILLS:	
Charging floors, loading yards	0.25
Rolling mills, sheet and bar mills, reheating furnaces	0.50
Wire drawing and straightening mills	1.00
TANNERIES:	
Dehairing, dehairing forms, pressing, tacking boards	0.50
Tanning paddle vats, putting-on machines, steam dryers, coloring and dyeing, measuring machines, blooding	0.50
Glazing machines, ironing machines, staking (knee, arm, machine), finishing tables, abrasive wheels, shaving machines, buffing, sorting of raw hides (for color after shaving), beamslers (or fine dehairing)	1.00
WOODWORKING:	
Carriage saws in long mills, mortiser machines, wood boring and bench work	1.00
Circular saw, band saw, swing saw, jointer, wood shaper, tenoning machine, planer, veneer cutter, resaws, wood-turning machines, sandpaper machines	3.00

TEXTILES (COTTON):	Light	Dark
Receiving and opening bales, openers, pickers, lappers, cards, slashers	0.25	0.50
Drawing frames, fly frames (slubbers and speeders), spinning frames (ring), twisters, spoolers, warping, doublers, nappers	0.50	1.00
Weaving, knitting, inspecting	1.00	2.00
TEXTILES (WOOL):		
Receiving and opening bales, pickers (burr, mixing, and rag), cards (breaker)	0.25	0.50
Garnetting machines, spoolers, cards (finishing), spinning (mule or jack), winders, washing extractors, boarding	0.50	1.00
Knitting frames, cutting, sewing machines (ribbing, finishing, seaming), examining	1.00	2.00
CLOTHING:		
Sewing, finishing and inspecting	3.00	5.00
Pressing and sponging	1.00	1.00
Cutting	2.00	2.00
Shrinking	0.50	0.50

is more desirable to observe conditions or operations in the light produced by the molten glass. In other operations it is more satisfactory to observe conditions by the silhouette effect, as in working with dark threads and lamp filaments. In all such cases in which work is of necessity carried on in comparative darkness special precautions should be taken to safeguard the workmen.

In order that the illumination should not fall below the specified minimum during the interval between inspections or cleanings, installations should be designed so as to produce initial illumination values at least 25 per cent higher than given in the table.

Power Needs of United States Nitrate Plants

Problems Involved in Building Two Plants Established by the Government at Sheffield, Ala., Near Muscle Shoals—Sites for Three Other Plants Selected at Indian Head, Md., and Toledo and Cincinnati—Economy of Operation Aimed At

BY EDWARD R. WELLES AND C. T. MITCHELL
Mechanical Division the J. G. White Engineering Corporation

BECAUSE of the dependence of this country upon Chile for its supply of nitrates and by-products, it was generally agreed before the war that we should have a source of supply within this country in case of a possible naval blockade. Consequently, appropriations were made by the government for the erection of huge nitrogen-fixation plants, the output to be used for the manufacture of explosives in times of war and for agricultural purposes during times of peace. Upon our entrance into the war the work on these plans was very much accelerated. A number of scientists and commercial investigators had been at work independently, the American Cyanamid Company having already erected a plant for the commercial fixation of nitrogen by the cyanamide process. At the same time the General Chemical Company was working on the subject, but along other lines, and it had developed a process which appeared to offer a number of advantages. The Nitrate Commission appointed by the government to investigate the relative merits of all known processes recommended the latter as the one on which to begin operations. This recommendation was adopted, and since the General Chemical Company had already prepared plans and purchased some equipment for a plant of its own, it was able to hasten matters by turning all these plans and equipment over to the government for the erection of nitrate plant No. 1.

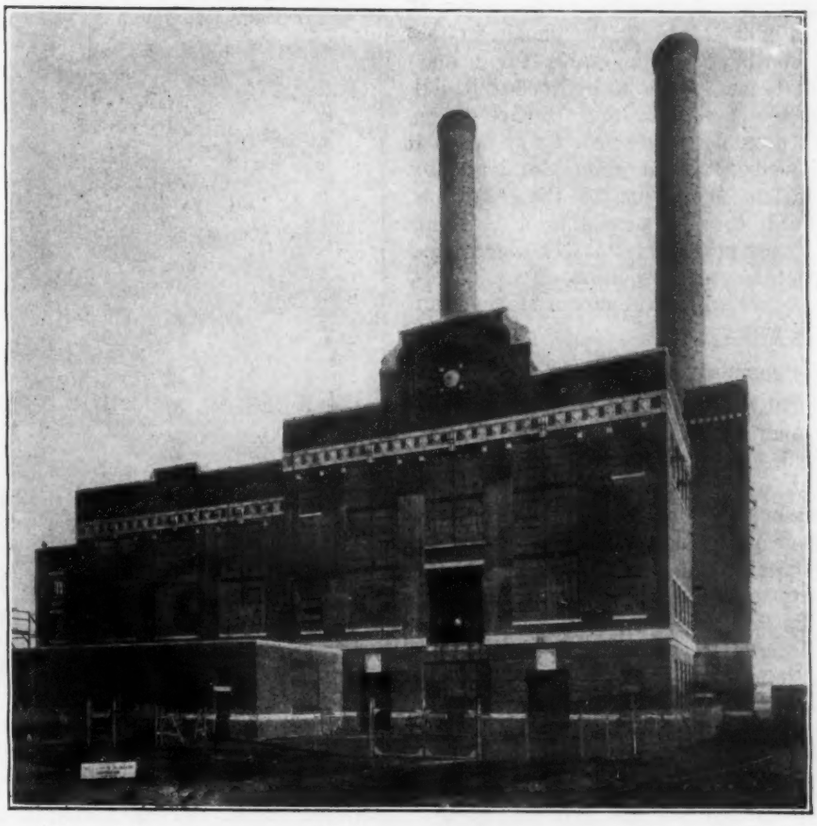


FIG. 1—POWER HOUSE SERVING NITRATE PLANT NO. 1

The Ordnance Department of the United States Army divided the work somewhat as follows: The general design of the ammonia process was placed in the hands of the General Chemical Company; the ammonia oxidation equipment was designed by the Ordnance Department; the design and erection of the chemical system for the absorption of the nitric oxide and the acid concentration was delegated to the Chemical Construction Company, and to the J. G. White Engineering Corporation was given the task of designing and erecting the various buildings and the power station. A site was selected, and the work began in the fall of 1917. When this work was well under way a second nitrate plant (No. 2) was decided upon, and for this plant the cyanamide process was adopted. The Air Nitrates Corporation, a subsidiary of the American Cyanamid Company, was organized to construct and operate the plant. Westinghouse, Church, Kerr & Company were selected as engineers to erect the necessary buildings for the process, and the J. G. White Engineering Corporation was selected to design and erect the power house for the plant.

When the armistice was signed plans had been made for three additional plants—the navy nitrate plant at Indian Head, Md., which was to be similar to nitrate plant No. 1, and nitrate plants Nos. 3 and 4 for the army, at Toledo, Ohio, and Cincinnati, Ohio, whose combined capacity was to equal that of nitrate plant No. 2.

The requirements which had to be considered in selecting a site for a nitrate plant included the following: (1) It should be inland so as to be easily defended from foreign attack; (2) it should be near a supply of coal and coke in order to avoid excessive freight charges, and (3) it should be as near as practicable to the center of the argicultural demand for nitrates. The city of Sheffield, in the northern part of Alabama, seemed to combine these advantages and was therefore chosen for the site of nitrate plant No. 1. Plant No. 2, which uses the cyanamide system, depends upon the use of the electric furnace, hence the power requirements are relatively large. For this reason a site first was selected at Sheffield because of the possibility of eventually using power from the Tennessee River at Muscle Shoals. The determining feature in the selection of the sites for No. 3 and No. 4 was the existing supply of electric power at these two localities.

For a number of years the development of the hydroelectric possibilities of the Tennessee River at this point has been discussed. This development, if carried on, is expected to give a constant supply of 90,000 kw. and a maximum of about 180,000 kw.; with a dam farther down the river a maximum of possibly 500,000 kw. will be available. It will also eliminate the shoals in the river and make it continuously navigable for nearly twice the present distance. Such a hydroelectric development, however, would require four or five years for construction, and possibly longer; so it was decided to install a steam-power station at plant No. 2 and to construct a high-tension connection to the Alabama Power Company's lines, thereby providing a total of 80,000 kw. in the shortest possible time. This arrangement is to be used pending the completion of the hydroelectric development, after which the steam station can be used for standby service.

SOME PROBLEMS INVOLVED

Approximately 20,000 men were required in the construction of nitrate plants Nos. 1 and 2, but since the three cities of Sheffield, Florence and Tuscumbia, which form one community, had a combined population of fewer than 10,000 persons (before the war) and had no near neighbors of large population, it was necessary to get the labor from outside the territory—from practically all the states of the Union. In many cases it was necessary to house the families and provide such utilities as gas, water, electricity, etc., as well as all other necessities of a small city.

Despite these huge difficulties, ammonium nitrate was being manufactured in less than one year after beginning the design of nitrate plant No. 1. This was done in spite of the fact that a certain amount of development work had to be done after the erection of the apparatus.

On Jan. 1, 1918, nothing but preliminary sketches, principally free-hand, had been made in the design of nitrate plant No. 2, and none of the equipment for the power plant had been purchased. Nevertheless, on Nov. 25, 1918, eleven months later, ammonium nitrate was being manufactured, using power from the Alabama Power Company's lines, and the first element of the 60,000-kw. turbine of the power house was about ready for operation. The second element was in the process of erection, and the third element was ready for shipment. The boilers and stokers were so far erected as to be ready whenever the turbine required steam.

The quantity of freight handled for this development was enormous and required the construction of special railway yards to provide for storage during unloading. One item alone may give some idea of the magnitude. The 60,000-kw. turbine installed in power house No. 2 required more than forty railway cars to bring it from the manufactory, and this train did not carry the condensers and some of the condenser accessories Similar comparisons might be made of almost every other feature of this project in both power-house and process buildings.

HOW PROCESS USED AFFECTED POWER PLANT

The nitrogen-fixation systems adopted for these two plants differ considerably. The cyanamide system, employed at No. 2, utilizes the electric furnace in the manufacture of calcium carbide, which with the addition of nitrogen gas obtained by a partial liquefaction of air becomes calcium cyanamide; from this substance ammonium nitrate is derived. For this work there are

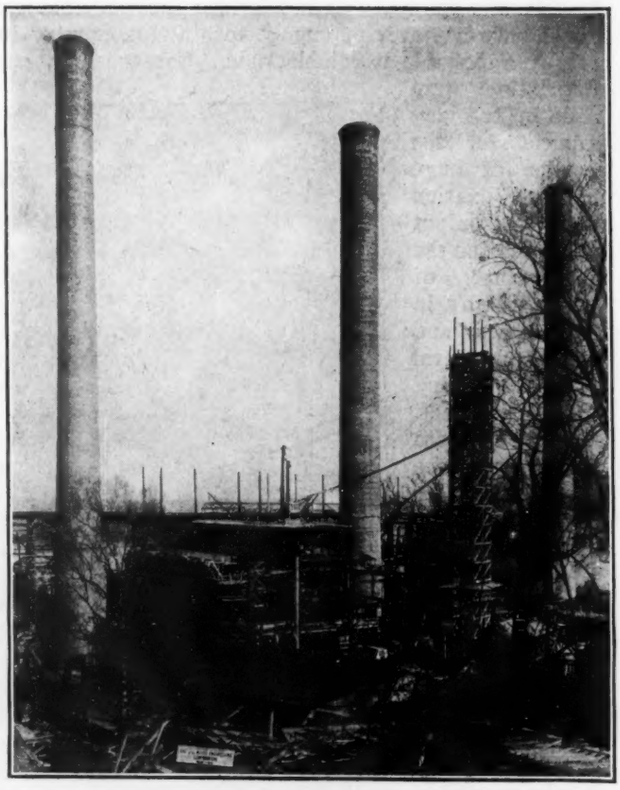


FIG. 2—NITRATE POWER PLANT NO. 2, UNDER CONSTRUCTION, WHICH WILL HAVE AVERAGE LOAD GREATER THAN BROOKLYN'S PEAK LOAD

installed twelve electric furnaces, each requiring 6000 kw. Ten will always be in operation, giving a load of 60,000 kw. This equipment, together with the motor load, will bring the load to about 70,000 kw. or 80,000 kw. with a load factor of about 90 per cent. The large and very constant load required the erection of a station similar to a central station, designed for as high an economy as war conditions would permit.

The process at nitrate plant No. 1 is essentially a contact process, depending on the direct chemical union of the gases necessary to form ammonia in the presence of a catalytic agent. It does not lie within the province of this article to discuss the process; it is sufficient to state that the power load consists principally of motors, operating pumps, compressors, etc., but a proportionately

large quantity of both high and low-pressure steam is required. Hence, while plant No. 2 has 60,000 kw. turbine capacity (70,000 kw. maximum) and 18,000 boiler-hp., or 3.3 kw. per boiler--horsepower, plant No. 1 has 4000 boiler-hp and 5000 kw. turbine capacity, or 1.2 kw. per boiler-horsepower.

The engineers in charge of work on these stations were faced with the problem of accomplishing the design and erection within a space of time unheard of before, and also at a time when deliveries of material were extremely slow. The fact that the jobs were given a high priority rating very much aided the obtaining of material, but every manufacturer was crowded with government work of the utmost importance and of great urgency; hence the difficulties of obtaining equipment were very great. The ordinary routine in the design and construction of such plants, therefore, had to be abandoned. It was necessary to purchase all of the principal apparatus before the general design of the complete station could be decided upon and to suit the station design to the equipment available. The clearing of the site had to be carried on while the buildings were being designed; the design of the buildings had to be based upon preliminary layouts of apparatus, and there was no time left for radical changes.

The life of these stations after the conclusion of the war is dependent upon their economy. It was, therefore, important that the design should be such as to permit high economy of operation if the project was to be an ultimate success. It was consequently decided to adhere as closely as possible to a design which would result in as high a degree of economy as was practical, but that none except standard forms of apparatus would be purchased and that no feature would be tried unless there was absolute assurance of its satisfactory operation. Additional interest is given to these stations because they were designed and built in record time but without a sacrifice of the principles of economical design.

The generating equipment of plant No. 1 consists of three turbines and a steam-driven exciter, the latter used for starting up. Two of these turbines are rated at 1875 kva., the third at 1250 kva. The latter unit had been purchased by the General Chemical Company for its own smaller plant before being taken over by the government. The turbines are interesting in that they are of the bleeder type, delivering a certain amount of steam to the process from the 10-lb. (700-gm.) pressure stage, the rest to the condenser. The amount of steam bled from the turbine is controlled by a large diaphragm valve operated by the pressure in the process pipe line. The amount bled may be as high as 95 per cent of the total steam delivered to the generator, or it may be nothing at all, according to the demand for exhaust steam. In case the demand should cease, the turbine becomes a straight condensing turbine. The turbine thus acts as a pressure regulator for the process steam; this is the most important function of the bleeding operation. As a matter of fact, the demand for steam in the process is fairly constant, there being no violent fluctuations to cause wear and tear on the regulating mechanism. Since all the auxiliaries in the power plant are steam-driven and exhaust steam is available from four air compressors as well (two of which are in constant operation), there is a considerable excess of exhaust steam over that required to heat the boiler-feed water. This excess is delivered to the process along with the steam extracted from the turbines. A small amount of steam from the process line is admitted to the feed-water heater by means of a thermostatic valve, in order to maintain a constant temperature in the boiler-feed water. From 10 per cent to 30 per cent of the low-pressure process steam comes from the turbines, according to the demand. Since a considerable proportion of the total steam is non-recoverable, there were no special advantages to be gained by the use of surface condensers, and therefore low-head jet condensers, installed directly underneath the turbine, were used. As direct current chiefly is used in the plant, power is developed at 190 volts, 60 cycles, six-phase, and most of it is converted in three rotaries installed opposite the turbines on the turbine-room floor.

Though nitrate plant No. 1 is modern and up to date throughout, the above outline probably covers all the general features, outside of the electrical equipment (which will be taken up in a subsequent article), and will give a general conception of the wide differences between this station and station No. 2, a detailed description of which is to appear later.

WAR-TIME FINANCING IN COLUMBUS, OHIO

Generating Unit Bought with Some Aid from War Finance Corporation, but Delay in Boilers Hampered Full Operation

How the Columbus (Ohio) Railway, Power & Light Company financed the cost of a 10,000-kw. turbine with some aid from the War Finance Corporation is explained in the annual report for 1918. The purchase of the unit and the delay in operation of the turbines under full load because additional boilers have not yet been installed are described as follows by Norman McD. Crawford, the vice-president:

The last annual report refers to the completion of the new Walnut power station with a 15,000-kw. unit. The company had previously taken an option on a second unit of 10,000 kw., and on account of the rapidly increasing power load due to war demands plans were prepared to install this second unit provided its cost could be financed. On account of the impossibility of selling bonds or other securities in the usual way to provide for the floating indebtedness and other requirements of the company, application was made to the War Finance Corporation for a loan of sufficient size to cover all the requirements including the increased power capacity for war purposes. The final result of these negotiations was the issue of a two-year note issue for $2,500,000, $750,000 of which was taken by the War Finance Corporation and the balance placed among the creditors of the company. The War Finance Corporation required as a condition of this subscription that the new 10,000-kw. power unit should be installed in the Walnut station to provide for the demands for power for war purposes. This installation was therefore decided upon and has been progressing. Operation of the 10,000-kw. turbine was started in November, and complete installation of boilers, etc., can be finished within the next six months.

During the early part of the year the boiler installation for the 15,000-kw. turbine which was installed at the Walnut power station during 1917 was completed, and this turbine has been operated up to capacity since that time. During December the second generating unit, a 10,000-kw. turbine, was placed in service at this station. The boilers for this unit, however, have not yet been installed, though the foundations for these boilers and the building to contain them are now under way, and it is anticipated that this boiler installation will be completed during the first six months of 1919.

Economical Operation of Water Turbines

Determination of the Value of the Principal Losses That May Occur, and Methods of Locating Their Origin—Keeping of Records and Their Utilization—Inquiry Into the Effect of Losses on Output

BY F. H. ROGERS
Hydraulic Engineer, I. P. Morris Department, William Cramp & Sons Ship & Engine Building Company

ECONOMICAL operation of water turbines has to receive careful study from the engineers and operators of hydroelectric stations in order to meet the load demands with the least possible expenditure of water. In such a study consideration must be given to the flow conditions in the river, storage and draw-down, the daily load demand curves, the sudden load changes and the characteristic curves of the turbines. This problem differs in different plants since it depends on

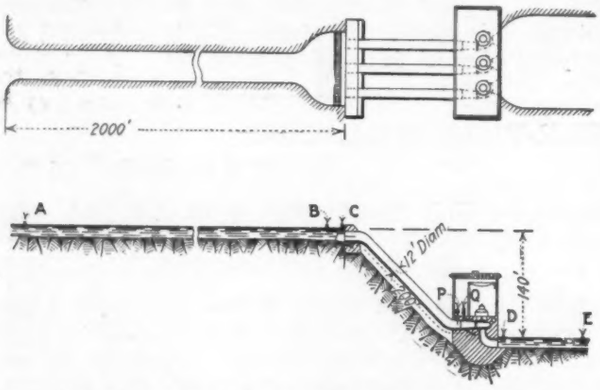


FIG. 1—POSITIONS FOR WATER GAGES IN A SPECIFIC HYDROELECTRIC PLANT

local conditions. It is not the intention of the author to deal with this phase of the matter.

However, in a great many power stations little attention is given to maintaining the efficiencies obtainable when the plant was first built, and no systematic methods are used for checking up the efficiencies or hydraulic losses from time to time. In some plants it is customary to shut down the turbines at stated intervals and inspect the interior parts, but such a practice is not economical and in many instances may be unnecessary. It is possible by the installation of a few simple gages and by careful records of their readings to determine whether the efficiencies are being maintained. If a decrease is noted, it is often possible to determine where the loss is occurring so that a rapid inspection may be made. It is this phase of the subject which will be discussed.

In general such losses may be divided into two groups, (1) friction losses and (2) leakage losses. The former are usually caused by obstructions in the water passages and the latter by actual leakage at drain valves or other parts of the system, or by wear at the runner seals.

APPARATUS AND DATA NEEDED

To determine the value of these losses and to locate their cause it is necessary to have available characteristic curves of the turbines and gradient curves for the water passages and to install elevation gages along the canal, in the forebay and tailrace, pressure gages along the penstock, and a quantity gage near the turbine. To explain the method of using these gages a plant will be considered containing three 15,000-hp. turbines operating under a head of 140 ft. (42.7 m.), the general layout being as shown in Fig. 1. In such a plant elevation gages should be installed at *A*, *B*, *C*, *D* and *E*, a pressure gage at *P* and a quantity gage at *Q*.

The characteristic curves required are as follows: The gate opening for various generator outputs and heads (Fig. 2) and the gate opening for various quantities of water and heads (Fig. 3). These curves are plotted for the gross head at the power station as given by the difference between the readings of gages *B* and *D* and should cover the range in heads likely to occur.

The gradient curves required are those which show the drop in elevations, for various quantities of water flowing, along the canal, through intake racks, and down the penstock as shown in Figs. 4 and 5. It should be noted that the drop in head shown is made up of friction losses plus velocity head, as the various gages referred to do not, of course, measure the velocity head.

All of the above curves should be plotted from readings obtained by actual tests made at the site after the plant is first installed. If for any reason such tests are not made, the curves shown in Figs. 2 and 3 may be plotted from data furnished by the turbine and generator manufacturers. The gradient curves shown in Figs. 4 and 5 may then be plotted from the actual readings taken on the various gages mentioned. The latter method of obtaining the curves is, of course, not so accurate as the first method, but it will give relative results, by means of which the operation of the turbines may be compared from time to time.

The quantity gage referred to measures approx-

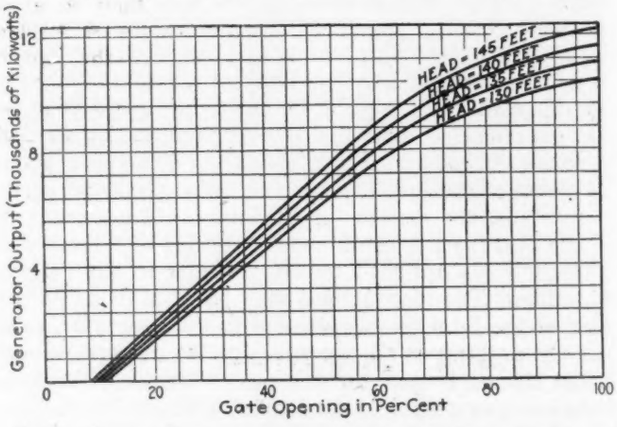


FIG. 2—GATE OPENING FOR VARIOUS GENERATOR OUTPUTS AT DIFFERENT HEADS

imately the difference in velocity heads at two sections of the penstock and hence works on the principle of the Venturi meter. Fig. 6 shows on a large scale a design of quantity gage and the method of connecting it to the turbine penstock. It may be noted that one arm of the gage is attached to the large end of the taper section of penstock, 12 ft. (3.7 m.) in diameter, and the other arm of the gage to the small end of the taper section, 9 ft. 6

in. (2.9 m.) in diameter. For the particular turbine under consideration the quantity flowing at the gate opening for maximum efficiency would be about 960 cu.ft. (27 cu.m.) per second, and hence the difference in velocity heads at the two sections where the gage is attached is equal to about 21 in. (53 cm.), which will be

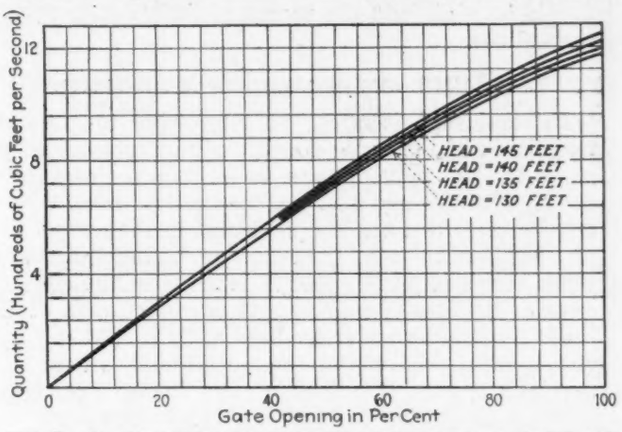


FIG. 3—GATE OPENING FOR VARIOUS QUANTITIES OF WATER AND DIFFERENT HEADS

approximately the difference in reading between the two columns on the quantity gage. By the admission of compressed air to the top of the gage it is possible to bring the water levels in the two tubes within the range of the scale on the gage, so that the difference may readily be observed. This quantity gage should be calibrated at the time the tests are made on the turbine by plotting its readings against the actual quantities flowing as measured by Piot tubes, weir or other approved method, so that at any time thereafter the actual quantity flowing through the turbine can be readily determined.

In the case of the particular turbine under discussion the velocity difference at the two sections is of sufficient magnitude to obtain a large difference in readings on the gage board and hence avoid errors. In the case of a low-head plant where the velocities in the water passages are small it is advisable to use the quantity gage in connection with a differential fluid so as to multiply the readings. Thus in the case of a plant operating under a head of 30 ft. (9.1 m.) the velocity

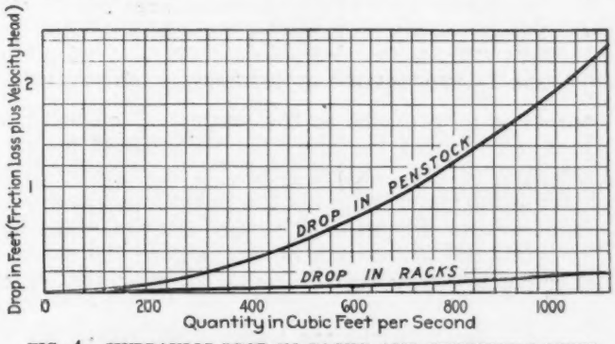


FIG. 4—HYDRAULIC DROP IN RACKS AND PENSTOCKS WITH DIFFERENT QUANTITIES OF WATER FLOWING

near the entrance to the casing would be about 6 ft. (1.8 m.) per second. In such a plant the penstock or intake passage would probably be short so that it would be possible to attach one arm of the quantity gage to a point near the intake of the casing and the other arm to the forebay, in order to obtain as great a difference in velocity head as possible. For conditions such as assumed above the reading on the quantity gage would be about 6.7 in. (17 cm.), which is rather small for the required accuracy. In such an installation a method which can be used to advantage is to invert the quantity gage as shown in Fig. 7 and to fill the lower part with a liquid having a greater specific gravity than water. Carbon tetrachloride, such as is used in Pyrene fire extinguishers, will give satisfactory results. This fluid should be colored by one of the coal-tar dyes which is soluble in the carbon tetrachloride but insoluble in water, in order to give a distinguishing color so that the water surfaces in the gage may be easily read. As the specific gravity of carbon tetrachloride is about 1.5, the velocity head reading on the gage board is multiplied by two, so that for a velocity, as assumed above, of 6 ft. (1.8 m.) per second, the gage reading would now be 13.4 in. (34 cm.).

CHECKING PERFORMANCE

Returning to the actual methods of checking the efficiency and operation of the turbines, readings should be taken at stated intervals of gate opening, generator output, quantity and all gages and compared to the normal conditions, as shown on the curves in Figs. 2, 3 and 4, for the particular gross head as obtained from the readings of gages *B* and *D*. Two general cases may be considered:

Case I.—If the readings indicate a reduction in gen-

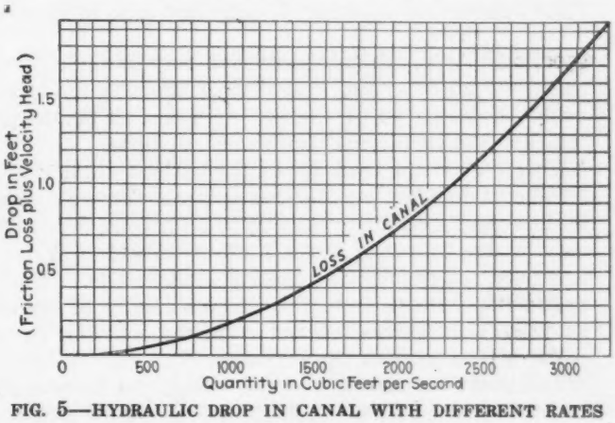


FIG. 5—HYDRAULIC DROP IN CANAL WITH DIFFERENT RATES OF FLOW

erator output and a reduction in quantity used by the turbine, the trouble may be due to one of several causes, namely: (1) Obstruction at the racks; (2) obstruction in the penstock; (3) obstruction in the turbine; (4) obstruction in the draft tube; (5) leakage from the penstock at some point above the quantity gage.

By comparing the actual drop in head as obtained from the gages, through the racks and in the penstock to the normal values as shown by curves (Fig. 4), it can at once be decided whether to eliminate these parts of the system from the investigation. If an excessive drop is noted, it should not at once be assumed that obstructions are present, as the drop may be due to leakage, so that the actual quantity flowing through the racks and in the penstock is greater than the quantity passing through the turbine as read on the quantity gage. A careful examination of all drain valves and other connections to the penstock will usually settle this point. If no leakage is discovered and the gages indicate an excessive drop through the racks, the openings are undoubtedly clogged and the racks should be raked or if necessary removed and cleaned. If the drop in head occurs in the penstock, the unit must be shut down for examination. If the gages indicate no ex-

cessive losses in these parts, the condition of the tailrace should next be examined for indications of obstructions. Accurate readings in the tailrace are usually difficult to obtain owing to turbulent flow. It is unusual for obstructions to lodge in the draft tube owing to the large size of the water passages, but it is possible for the tailrace partly to fill up with débris and thus cause a loss in head. The appearance in the tailrace of a drop in elevation at any particular section would indicate an obstruction.

So far in the investigation it may have been unnecessary to shut down the turbine. If, however, no additional losses are found through the racks, in the penstock or tailrace, it is evident that the trouble is in the turbine itself and the unit should be shut down for inspection. Although an obstruction may be found in the casing or guide vanes, it will most probably be located near the discharge of the runner vanes as these openings are the smallest of the water passages.

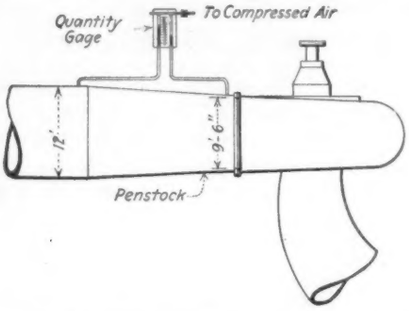


FIG. 6—METHOD OF CONNECTING QUANTITY GAGE TO PENSTOCK

Case II.—If the readings of the various gages and instruments indicate a reduction in generator output and an increase in quantity used by the turbine, the trouble may be due to one of the following causes: (1) Leakage from the penstock at some point below the quantity gage; (2) leakage from the turbine casing or its connections; (3) excess leakage from wear at the runner seals; (4) a broken runner vane.

The first two possibilities can usually be investigated by an examination of all drain valves, relief valves or other connections to the penstock or casing below the quantity gage. If no leakage is found at these points, the unit should be shut down and the interior parts inspected. The most probable cause of the trouble is wear at the runner seals, causing excessive leakage. This should be remedied by renewing the seal rings. Such wear is of greater importance the higher the head on the unit, for, because of the characteristics of the design of high-head turbines, the runner diameter and hence the area at the seals is proportionately greater than in the case of low-head units, so that the same amount of wear results in a greater excess leakage in the former type. Thus, in the case of the unit considered above, operating under a head of 140 ft. (42.7 m.), if the clearance at the seals is increased by wear from $\frac{1}{32}$ in. (0.79 mm.) to $\frac{1}{16}$ in. (1.6 mm.), the excess leakage will amount to approximately 7 cu. ft. (0.2 cu.m.) per second, or nearly three-fourths of 1 per cent of the total flow through the runner. For a wheel operating under a head of say 30 ft. (9.1 m.) a similar amount of wear at the runner seals only results in an excess leakage of two-tenths of 1 per cent of the total flow.

It should be noted that so far in the investigations the gross head from the forebay to the tailrace has been used, so that possible losses in the canal have not been considered. Readings should also be taken of the drop in the canal from gages *A* and *B* and compared to the normal drop, as shown in Fig. 5, for the total quantity passing through all the turbines. Losses may occur from obstructions or deterioration of the canal lining, and if such losses become excessive, an examination should be made and the necessary dredging or repairs carried out.

Loss Limits and Accuracy of Measurements

In conclusion, it might be interesting to state the magnitude of the losses which can be measured on the gages and the value of these losses from a viewpoint of power, efficiency and quantity for the particular turbine considered in this article. A change in the normal flow of 1 per cent can readily be measured as such a change would result in a difference in reading on the quantity gage of 0.37 in. (9.4 mm.). Even in the case of the turbine operating under the head of 30 ft. (9.1 m.) previously mentioned, if the differential fluid is used with the quantity gage, it is also very easy to read a change in quantity amounting to 1 per cent, as in this particular instance the reading on the quantity gage would change 0.26 in. (6.6 mm.).

Considering the value of the losses in the operation of the plant, it may be stated that an increase in water flow of 1 per cent, due to the leakage, results in a loss in efficiency of at least the same amount and a slight loss in power due to the additional friction loss from the larger flow. On the other hand, a decrease in quantity of 1 per cent due to an obstruction in the runner results in a loss in power of at least 1 per cent and an efficiency loss due to the disturbed flow conditions through the runner. If the decrease in quantity is caused by an obstruction in the penstock, the power and efficiency losses become of even greater magnitude, for in such a case the reduction in flow is the result of a loss in head which affects both the power and efficiency.

The quantity of water flowing varies as the square root of the ratio of the effective heads, and as the power output is proportional to the product of quantity and head, this output varies as the three-halves power of the ratio of the effective heads. The efficiency is the ratio of the power output to the power input, and as the input is also proportional to the quantity, this input varies as the square root of the ratio of the heads, so that the efficiency varies directly as the ratio of the heads.

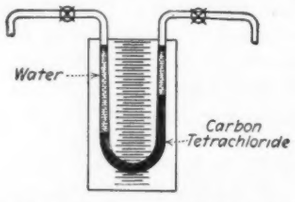


FIG. 7—MODIFICATION OF ORDINARY QUANTITY GAGE

The above relations are shown more clearly by the following formulas in which:

$HP_1Q_1E_1H_1$ = The initial horsepower output, quantity, efficiency and head.

$HP_2Q_2E_2H_2$ = The final values due to a loss in head of $H_1 - H_2$.

$$\frac{Q_2}{Q_1} = \left(\frac{H_2}{H_1}\right)^{\frac{1}{2}} \qquad (1)$$

$$\frac{HP_2}{HP_1} = \frac{Q_2 \times H_2}{Q_1 \times H_1} = \left(\frac{H_2}{H_1}\right)^{\frac{1}{2}} \frac{H_2}{H_1} = \left(\frac{H_2}{H_1}\right)^{\frac{3}{2}} \qquad (2)$$

$$\frac{E_2}{E_1} = \frac{HP_2}{Q_2H_1} \Big/ \frac{HP_1}{Q_1H_1} = \left(\frac{HP_2}{HP_1}\right) \Big/ \left(\frac{Q_2H_1}{Q_1H_1}\right) = \left(\frac{H_2}{H_1}\right)^{\frac{3}{2}} \Big/ \left(\frac{H_2}{H_1}\right)^{\frac{1}{2}} = \frac{H_2}{H_1} \qquad (3)$$

To understand the application of the above formulas assume a reduction in the effective head of 2 per cent; hence:

$$Q_2 = (0.98)^{\frac{1}{2}}Q_1 = 0.99Q_1$$
$$HP_2 = (0.98)^{\frac{3}{2}} \quad HP_1 = 0.97HP_1$$
$$E_2 = 0.98E_1$$

Thus the quantity is reduced 1 per cent, the horsepower 3 per cent and the efficiency 2 per cent.

What Output Loss Would Mean Financially

Expressed in dollars and cents, such a loss in output would mean a decrease of value of the same percentage for the entire development, including the canal, dam, power house, water rights, transmission lines, and in fact everything which is covered by the total capital investment.

University Training for Engineers

A Broader Outlook, a Fair Knowledge of Economics and Government and Human Sympathies Are Necessary if the Engineer Is to Be Equipped Properly for His Work

BECAUSE of the wide general interest shown in the speech of President Emeritus Charles W. Eliot of Harvard University at the meeting of the American Institute of Electrical Engineers in Boston, March 14, that portion of it dealing with the training of the engineer is published below. As stated in the ELECTRICAL WORLD of March 22, Dr. Eliot's address was most inspiring, and inasmuch as he sees an enormous field of opportunity and usefulness ahead of the engineer his comments are worthy of note and wider study:

"I must go on to speak of the demand for first-class engineers. It is a very small demand at the best, but to fill that small demand is one of the most important tasks of American teachers and universities, because democracy does not lead only to raising the level, improving the capacity of the average man, but should lead to the development and profitable employment of men of superior ability in all sorts of human service. James Russell Lowell pointed out many years ago that unless democracy developed and set to work the highest types of human intelligence and character it would be a failure.

"I believe that to be a statement of absolute truth, gentlemen, not sufficiently understood and appreciated by the mass of educated Americans. The test of our form of government is going to be its capacity to develop scholars, research men, students and practical geniuses of the highest type. How is that to be accomplished?

"Does not the selection for the super-engineer or the super-statesman or the super-lawyer work well in this country—indeed, work quite as well as in any country—with this added advantage, that democratic society being plastic, not crystallized in layers as is society in some other countries, some of which are very impermeable, it results that throughout society, from bottom to top, there is a plasticity, a condition of yielding, with the natural impulse for talent to rise to all layers of society? That I believe to be one of the chief advantages of democratic society. It gives a man who has natural genius and superior talent a chance to go to the top. We had a wonderful case of that in Abraham Lincoln. It was because of democratic society and the opportunities which it offered that Abraham Lincoln attained his immortal vein.

"So I believe that these supermen whom we all want to bring forth in our democratic society will be brought forth, at any rate in many instances, and put in their proper places, and it is the first duty of our advanced institutions of education to provide for them every possible chance.

"What is the motive that, after all, must inspire these young men who are to become what we call here tonight the supermen? It is the scientific motive, gentlemen, the love of the occupation itself, and the satisfaction with their station in life which gives them the chance to devote themselves absolutely to the pursuit or the work that they love. Is not that the way in which all geniuses of the world have found their place? Is it not the way, in the future, that this country will be supplied with the men who are, after all, the leaders of all our progress in all our fields of endeavor and opportunity, exploitive of natural resources and exploitive of the human imagination?

"Now, gentlemen, the way to get for the service of the country these supermen is, I think, first utterly to change from the bottom to top the methods of instruction now used in the elementary and secondary schools and the colleges of the country. We never can get through our free schools the boys we want and the girls we want until the methods of instruction in the elementary and secondary schools are changed.

"But we may look forward, I hope, to the universities being resorted to by boys who mean to be engineers of the first class. Why the universities? Because the engineer of the first class needs to have, to be sure, very highly specialized training, but he also needs to have a first-rate world training. He must not be ignorant of the modern languages; he must not be ignorant of economics and government and history. He needs familiarity with the great facts of all these subjects. He must be able to understand the new problems in government and economics as they arise. His profession requires that he be a man of good general training as well as a man of the highest special training. The good general training he must get in universities; and, again, the engineer of the first class needs contact with all kinds of people, being a leader. He needs in this country, particularly, to be able to deal with men. He must be able to deal with all classes of men, not only with supermen. In the case of all the professions, when you get up to the higher grades of public service, the leader, and particularly the engineer, must be a man who can deal with men with human qualities, as distinguished from the selfish, narrow-minded quality

which characterizes a great many of our lawyers, doctors, professional business men, manufacturers. We are getting away from these narrow conditions in all the professions, and it is of supreme importance that the great engineers should possess these sympathies and be able to make use of them in their contact with other human beings, to know their motives, their hopes and their desires. This is especially true of great engineers, because any great feat of engineering cannot be accomplished without the coöperation of multitudes of men of all sorts and conditions, and a great engineer must have the faculty of inspiring, at any rate, the leaders and managers of these multitudes.

"At this moment we are threatened with a great depredation of our population, a very great depredation indeed. I was listening to labor leaders at our State House this morning who advocated doctrines which, put into practice, would demoralize every man that came under their influence. For instance, there was advanced the doctrine of limited output.

"Now, we are threatened with a large development of men and women who will act on that doctrine. It is a very great threat. I myself attach no importance to the apprehension that vile socialists of any sort will get a chance in our country, but I think there is an indication about the broad adoption of labor doctrines which shows that these doctrines in their tendency are thoroughly demoralizing to the people who accept them. Any man who is employed in the designing or erection of great engineering work is liable to come in contact with these demoralizing forces. Through whom must he resist these forces? Through the managing force of the great corporation which employs him, or the great partnership which employs him, and these great leaders of engineering forces need to understand all these human relations and to know how to tell the corporation employers or the partnership employers how to overcome these conditions. The engineer cannot get his great designs executed unless he has that capacity and these comprehensive powers.

"Now, we need not expect that the number of first-class engineers to be employed by this country is going to be a very great number, but we must take courage from the fact that the number is increasing, and increasing very definitely, not only because more great teachers of engineering are employed in our higher technical schools and universities, but also chiefly because great corporations are employing great engineers to a much greater extent and at much larger salaries than were visible even twenty years ago, and as I go back fifty years, as I can do, just to the prime of my own powers of observation, I see an immense change for the better in the condition of engineers in American industries.

"Then we have to look forward to the altogether probable expansion of man's power over nature during the next twenty, forty or sixty years. That looks certain. Take, for example, the expansion of man's power over air which has taken place within the last fifteen years —yet that development is only on its threshold. It is one of the drawbacks, insignificant with regard to the great results, of the sudden closure of the great war that airplane work as a military art was only at the beginning of its development. We hardly got a chance to use our extensive preparation, but many of our soldiers have perceived that future wars are going to be carried on and won or lost in the air, not the land or water.

"That is just one field of probable expansion of man's power over nature as a means of overcoming these natural resistances.

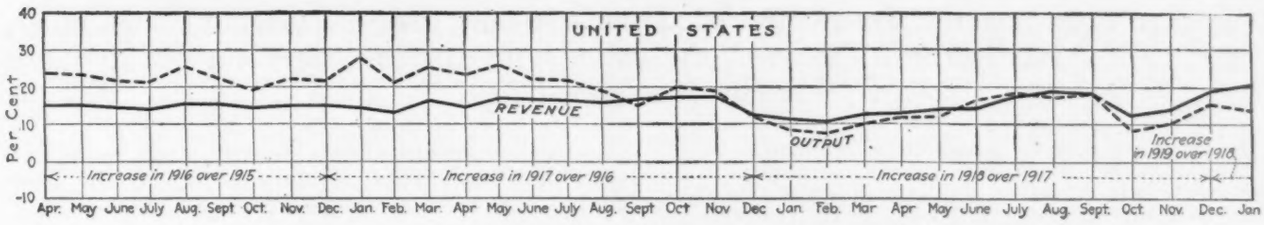
"Another sphere of this activity is in the recent development of locomotive forces—in the direction of new kinds of traction, new uses of the explosive engine. I first saw an explosive engine in use in 1864, in the streets of Paris—used, I mean, as a commercial vehicle —and see how the application of that explosive force was expanded in the next twenty years, and has been up to this date, and yet we are only at the beginning of that expansion, not at the middle or near the close, but we are only at the beginning.

"I remember when John F. Butler was Governor of Massachusetts. He and I attended a great celebration at Phillips Academy at Exeter, and we both spoke. He spoke first, and he announced that the great man of the future was going to be the engineer, not the politician, or the statesman, or the minister, or the doctor, or the lawyer, but the engineer; and the reason was that it was the engineer who had his hand on the throttle, that he was to control the material development of the country and put industries to work. I took exception to the statement in the remarks I made subsequently, because I thought there were a good many places in which the engineer did not have his hand on the throttle, at least so definitely and effectively as some of the other professions, but looking to the future we all see perfectly and clearly that the profession of engineering in its higher ranges is going to be perhaps the most serviceable of all of the professions in the direction of increasing the comfort of the population as a body—it is going to develop not only the material prosperity of the people, but the happiness of the people, their success in the pursuit of happiness, which is, after all, the great result to be achieved by civilization.

"Therefore we look forward with a great deal of assurance to the future great serviceableness of the profession which you gentlemen represent, and we welcome the great benefits to man which the service of this profession will render. It used to be considered a materialistic profession, but I do not know that there is any profession which involves a broader or more constant use of the human imagination, and also the broader use of what we may call truthfulness of mind, reverence for truth, obedience to truth and reliance on truth, for the civilization and advancement of the human race."

TO MY mind there are many good and sound reasons why the government should not attempt the nationalization of any industry, but I shall only mention two reasons. To begin with, I question the possibility of government success in the actual operation of any industry as many-sided and as sensitive as the oil industry. Nothing that the government has done either before the war or during the war has indicated that Uncle Sam is a good business manager or even a fair success as an industrial executive. Over and above that fact, however, as an argument against government ownership is the fundamental character of the American people. If we have any national trait worth enlarging and worth preserving, it is initiative and individuality.—*D. M. Folsom, Pacific Coast Petroleum Administrator.*

Central Station January Operations


UNITED STATES
REVENUE
OUTPUT
Per Cent
40
30
20
10
0
-10
Increase in 1916 over 1915
Increase in 1917 over 1916
Increase in 1918 over 1917
Increase in 1919 over 1918
Apr. May June July Aug. Sept Oct. Nov. Dec. Jan. Feb. Mar. Apr May June July Aug. Sept Oct Nov Dec Jan. Feb. Mar Apr May June July Aug. Sept. Oct. Nov. Dec. Jan

IT IS ENCOURAGING THAT STRIKING INCREASES ARE STILL MAINTAINED

JANUARY reports of central stations to the ELECTRICAL WORLD show a large rate of increase in output over the corresponding month of last year. The rate of increase in revenue was still greater. According to the preliminary statistics from 50 per cent of the industry, the gain in kilowatt-hour output in the first month of 1919 over January, 1918, was 13 per cent; the gain in gross revenue was 20.9 per cent. It is encouraging for the industry that such striking returns should be maintained by the companies in the early uncertainties of the peace period. For 52 per cent of the industry December showed increases of 12.9 per cent in output and 18.4 per cent in revenue. Thus January not only attains the December record but, on the face of the first returns, betters it. However, the January, 1919, figures are compared with increases in January, 1918, over January, 1917, which were less than the normal rates. In January of last year the coal conditions combined with extraordinarily severe weather and industrial readjustments in connection with the war to cause the rates of growth to slacken. This year January had few or no coal shortage difficulties, weather was favorable, and the hesitation in some industries was offset by the new activities which peace means to other industries. The figures bear out the general confidence which was felt in most communities that the aggregate demand for energy would not be lessened substantially whether it came from the industries of peace or those of war. At the same time sharp fluctuations in individual localities may ensue before the restoration of normal conditions.

An interesting feature of the present report is the fact that the percentage of increase in revenue is appreciably larger than that in kilowatt-hour output. This tendency has been noted in recent months, but the margin of difference is more extended.

Based on the statistics from 50 per cent of the industry, the ELECTRICAL WORLD estimates the record for January for the entire industry as follows: Revenue, $53,900,000; output, 2,496,004,000 kw.-hr.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1918	1917	Per Cent Increase	1918	1917	Per Cent Increase
Feb.	60	$24,690,000	$22,307,000	10.6	1,254,217,000	1,168,288,000	7.1
Mar.	60	25,396,000	22,702,000	12.3	1,418,222,000	1,294,561,000	9.4
Apr.	60	25,864,000	22,966,000	12.6	1,450,221,000	1,297,843,000	11.5
May	62	25,365,000	22,426,000	13.1	1,537,527,000	1,372,935,000	11.9
June	60	26,070,000	22,599,000	15.3	1,531,099,000	1,319,444,000	16.0
July	56	21,935,000	18,559,000	18.2	1,370,461,000	1,156,692,000	18.5
Aug.	61	26,891,000	22,690,000	18.5	1,647,510,000	1,417,150,000	16.3
Sept.	60	28,051,000	23,810,000	17.8	1,579,149,000	1,348,820,000	17.0
Oct.	56	26,254,000	23,228,000	13.0	1,517,866,000	1,392,359,000	9.0
Nov.	57	27,894,000	24,215,000	15.1	1,427,470,000	1,287,536,000	10.8
Dec.	52	27,774,000	23,456,000	18.4	1,351,731,000	1,196,990,000	12.9
		1919	1918		1919	1918	
Jan.	50	26,950,000	22,275,000	20.9	1,248,002,000	1,104,174,000	13.0

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States			Atlantic States			Central States			Pacific and MountainStates		
		Percentage of Industry Represented	1918	1917	Per Cent Increase	Percentage of Industry Represented	1918	1917	Per Cent Increase	Percentage of Industry Represented	1918	1917	Per Cent Increase	Percentage of Industry Represented	1918	1917	Per Cent Increase
REVENUE	Feb.	62	$2,995,000	$2,272,000	8.0	57	$9,473,000	$8,658,000	8.6	53	$7,779,000	$6,746,000	15.3	84	$4,443,000	$4,131,000	9.5
	March	62	2,985,000	2,724,000	9.2	59	9,904,000	8,922,000	11.0	53	7,947,000	6,735,000	18.0	84	4,560,000	4,321,000	5.5
	April	62	2,890,000	2,578,000	12.1	59	10,054,000	8,946,000	12.4	53	8,431,000	7,103,000	18.7	84	4,489,000	4,339,000	3.5
	May	62	2,810,000	2,530,000	11.5	64	9,929,000	8,613,000	15.3	53	8,217,000	6,956,000	18.1	83	4,805,000	4,327,000	12.0
	June	63	2,925,000	2,584,000	13.3	63	10,048,000	8,761,000	14.7	49	8,124,000	6,824,000	19.0	84	4,973,000	4,432,000	12.2
	July	62	3,037,000	2,511,000	20.9	62	9,278,000	7,961,000	16.5	42	4,998,000	4,116,000	21.4	88	4,622,000	3,971,000	16.4
	Aug.	63	3,138,000	2,585,000	21.4	63	10,147,000	8,722,000	16.3	51	8,223,000	6,823,000	20.5	85	5,383,000	4,560,000	18.0
	Sept.	64	3,268,000	2,811,000	16.2	57	10,143,000	8,631,000	17.5	51	9,251,000	7,703,000	20.1	86	5,389,000	4,665,000	15.5
	Oct.	63	3,360,000	3,036,000	10.6	51	8,822,000	7,924,000	11.3	50	9,218,000	7,848,000	17.4	81	4,854,000	4,420,000	9.8
	Nov.	64	3,695,000	3,238,000	14.1	54	10,092,000	8,883,000	13.6	50	9,073,000	7,542,000	20.3	81	5,034,000	4,552,000	10.6
	Dec.	64	4,097,000	3,449,000	18.7	47	9,551,000	8,153,000	17.1	46	9,656,000	7,937,000	21.5	75	4,470,000	3,917,000	14.1
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.	63	4,253,000	3,443,000	23.5	44	9,395,000	7,850,000	19.6	43	8,902,000	7,235,000	23.0	73	4,400,000	3,747,000	17.1
			1918	1917			1918	1917			1918	1917			1918	1917	
KW.-HR. OUTPUT	Feb.	62	110,454,000	102,562,000	7.7	57	438,721,000	403,122,000	8.3	53	358,276,000	342,257,000	4.5	84	346,766,000	320,025,000	8.4
	March	62	121,518,000	111,576,000	8.9	59	501,320,000	452,250,000	10.8	53	398,166,000	356,860,000	11.5	84	397,218,000	373,875,000	6.2
	April	62	117,416,000	101,888,000	15.2	59	497,460,000	431,786,000	15.2	53	437,054,000	392,304,000	11.4	84	399,126,000	372,465,000	7.1
	May	62	121,751,000	105,601,000	15.3	64	512,202,000	455,977,000	12.3	53	441,202,000	404,560,000	9.0	83	462,372,000	406,797,000	13.6
	June	63	125,809,000	103,292,000	21.8	63	527,773,000	461,396,000	14.4	49	423,439,000	366,382,000	15.5	84	454,078,000	388,374,000	16.9
	July	62	135,960,000	105,373,000	29.0	62	518,566,000	439,464,000	18.0	42	254,189,000	216,296,000	17.5	88	461,746,000	395,559,000	16.7
	Aug.	63	143,566,000	114,017,000	25.9	63	567,672,000	490,505,000	15.7	51	447,829,000	399,278,000	12.1	85	488,433,000	413,350,000	18.1
	Sept.	64	133,901,000	114,279,000	17.1	57	520,312,000	445,154,000	16.8	51	471,594,000	408,320,000	15.5	86	453,342,000	381,067,000	18.9
	Oct.	63	139,784,000	128,970,000	8.3	51	481,222,000	440,268,000	9.3	50	479,990,000	442,054,000	8.5	81	416,870,000	381,067,000	9.4
	Nov.	64	138,559,000	123,033,000	12.6	54	450,210,000	406,725,000	10.6	50	435,135,000	389,541,000	11.7	81	403,566,000	368,237,000	9.6
	Dec.	64	145,543,000	129,838,000	12.1	47	377,931,000	331,810,000	13.8	46	448,928,000	408,167,000	9.9	75	379,329,000	327,175,000	15.9
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.	63	143,254,000	124,632,000	14.9	44	352,387,000	300,093,000	17.4	43	409,627,000	355,745,000	15.1	73	342,734,000	323,704,000	5.9

Export Opportunities in Foreign Countries

Conditions Bearing on the Development of Markets for United States Electrical Manufactured Products in All Parts of the World at the Present Time and in the Next Few Years

In connection with the report of the international trade committee presented before the annual convention of the Associated Manufacturers of Electrical Supplies at New York on March 20, addresses were made bearing on export trade conditions. Extracts from the addresses of Joseph McElroy, 3d, and William Burgess are printed herewith.

IN DISCUSSING "Opportunities for the Sale of American Electrical Articles in Foreign Countries," Joseph McElroy, 3d, export sales manager for Pass & Seymour, Inc., reviewed generally the conditions in the entire world.

Mr. McElroy took up first the West Indies, including Cuba, Porto Rico, Haiti and Santo Domingo as well as Bermuda and what is usually known as the West Indies group. The possibility of sale of electrical articles in this section is somewhat limited, with the exception of Cuba and Porto Rico, in which a large volume of American electrical articles has been sold and can be sold. Haiti and Santo Domingo are still in their commercial infancy, and the possibilities of sale in these countries during the next ten years are much greater than during the past ten.

In Jamaica and Bermuda the sale of electrical articles is quite limited owing to the fact that the population is small and purchasing power is also of comparatively little value. Nevertheless, it is the opinion of Mr. McElroy that the opportunities in the coming years will increase rather than decrease in this field.

THE SOUTH AMERICAN FIELD

Coming to South America, with Venezuela, British, French and Dutch Guiana, Brazil, Argentina, Uruguay, Paraguay, Chile, Peru, Bolivia and Colombia, the speaker said that there is a market for American electrical articles in all of these countries, particularly in Brazil. Brazil is a very large purchaser of American manufactured products.

In Argentina the main market is the city of Buenos Aires, but once outside this city, going south, the country is still practically undeveloped.

Uruguay is a good market. Paraguay is a small country and the market is also small. Chile, Bolivia, Peru, Colombia, Venezuela are all growing markets, Mr. McElroy said.

Going north to the various Central American countries near the Isthmus of Panama and to Mexico, the speaker declared it probable that Mexico will be a very large buyer of American electrical articles during the coming years as soon as the political disturbances have subsided and a stable government has been established. Many of the large plantations have water power, and it is logical that America should supply their needs. So far as Central American countries are concerned, the sale of American products is somewhat limited and probably will be for a long time to come.

Going on to speak of Europe, Mr. McElroy first mentioned the British Isles. It is possible to sell many articles of American manufacture in the British Isles, though it is true that Great Britain is one of the principal competitors of this country in this line. The same thing holds good for Norway, Sweden and Denmark. They are large consumers of electrical articles, particularly Sweden, where there are plenty of waterfalls. Electricity is very cheap in Norway and Sweden. In Denmark electricity cannot be supplied in sufficient volume for the demand, and the rate at present is quite high. Norway is supplying energy through a cable to Denmark, but is not able to furnish all that is desired.

OPPORTUNITIES IN FRANCE, BELGIUM AND OTHER EUROPEAN COUNTRIES

France will also be a consumer of American electrical products, though France is also to some extent a competitor. Belgium will be a consumer of many electrical articles, and it very much prefers to buy from American merchants rather than from the merchants of any other nationality. Portugal and Spain, Italy and Switzerland are also customers for our goods. Italy and Spain are to a certain extent manufacturers of electrical articles.

It is scarcely necessary, said Mr. McElroy, to say anything regarding the German Empire or of Austria-Hungary and Turkey. Passing down into Mesopotamia, Arabia and the entire Levant, including Greece, Serbia, etc., it is quite probable that many articles manufactured in the United States will be sold in this section during the coming five or ten years. This entire section is now taking on a new lease of life.

It is possible to sell American products in Egypt, Tripoli, Tunis and Morocco, though in some instances it is necessary to make special articles suitable for these markets.

AFRICAN AND ASIAN MARKETS

The speaker thinks that it is very probable that within the next ten or fifteen years a large market will develop in various parts of Africa. At present the main market is in the south in Cape Colony and to a slight extent up the east coast. Naturally articles of British manufacture obtain the preference, but if American manufacturers use as much skill, ingenuity and resourcefulness in this market as they have used in other sections of the world, particularly in their own country, there is no reason why they should not capture a fair proportion of the trade.

India is a very large consumer of cheap electrical devices. At present Japan probably dominates this market, but this does not mean that American articles will not sell or do not sell there. That most of the articles sold at present are Japanese is due solely to their low price without regard to quality. This remark applies also to Siam, the Malay Peninsula, Sumatra and Borneo, but not so much to the Dutch East Indies. The Dutch East Indies have a population of more than 40,000,000 people and prior to the war were accustomed to buy their merchandise through Holland, leaving the mother house in Holland to place the order with manu-

facturers in America or Britain or wherever it pleased. During the war a new condition sprang up, and many of the merchants acquired the habit of dealing with American manufacturers. This condition still exists and Mr. McElroy doubted very much whether the old triangle arrangement would ever be resumed. This market uses a better grade of merchandise than India. The credit of most of the merchants is excellent and they are large consumers of certain articles.

CHINA, JAPAN, SIBERIA AND AUSTRALIA

China should be a very prolific field for American manufactured electrical articles of many kinds. Japan to a certain extent has obtained control of this territory owing to the fact that it is situated near by and has supplied very cheap goods made up especially for this market. The Chinese will do business with American manufacturers if met halfway and given what they need or desire. It is practically impossible to sell any articles of American make in Japan. At present it is impossible to do business in central Russia because of the unsettled and unstable government, but it is possible to do a certain amount in Siberia. Siberia has a population of 11,000,000 people, and these people today are practically destitute of all manufactured wares with the exception of a certain amount of foodstuffs and clothing. They have plenty of raw material, such as hides, skins, bristle, timber, minerals, etc., which eventually they will exchange for manufactured articles, and they are strongly inclined to do business with America.

Continuing, the speaker said that Australia and New Zealand present a very favorable opportunity for the sale of American articles. Strong British competition will be met, but there is no reason why many American articles should not be sold in this territory.

So far as the Philippine Islands are concerned, there is a preference for articles of American manufacture, as there is also in the Hawaiian Islands. American articles of various types are sold in Iceland, and there is a possibility of selling many articles in Canada and Newfoundland, said Mr. McElroy.

MR. BURGESS TALKS OF CONDITIONS IN CANADA

William Burgess, tariff adviser to the international trade committee, spoke of the great growth of the electrical industry in Japan. He said that the electrical industry as such is not classed separately in Japan; the only branch so classified is the porcelain. There are now three large factories devoting themselves to this branch of manufacture.

The United States is Japan's largest customer. In 1917 the total exports were $801,502,524. Of this amount the United States took $251,780,352. In 1918 Japan's exports to this country increased more than $50,000,000. These goods were produced at an average labor cost of 26 cents a day. Owing to the rice riots last year labor generally received an advance of 50 per cent, making the average wage about 39 cents per day.

The growing demand for electrical goods of all kinds is indicated by the rapid growth of the light and power plants, said Mr. Burgess. In 1907 Japan had 112 such companies, supplying 950,453 lamps (calculated on 10 cp.) and 33,265 kw. for power. In 1916 there were 520 companies, supplying 10,790,776 lamps and 200,400 kw.-hr. power. Motors reported in 1907 were rated at a total of 8278 hp. and in 1916 at a total of 245,470 hp.

SUCCESSFUL CO-OPERATIVE CONTROL OF WATER POWER

New Hampshire Water Conservation Commission Told Agreement Saved Nearly 400,000 Tons of Coal Yearly in Maine and New Hampshire

An interesting outline of the successful control of stream flow by a coöperative organization of water-power users in Maine was recently presented to the New Hampshire Water Conservation Commission by Walter H. Sawyer, consulting engineer, Lewiston, Me. Mr. Sawyer referred particularly to the work of the Androscoggin Reservoir Company, which was organized in 1909 to build the Azisoohos Dam on the Magalloway River, thereby creating a reservoir of about 9,500,000,000 cu.ft. (266,000,000 cu.m.) capacity. The dam and reservoir are both in Maine. A charter was obtained from the State giving the right to take a part of a public lot at one end of the dam site and to flow portions of other public lots above. Other rights of construction and flowage were purchased from private owners.

The four largest users of power on the Androscoggin River—the Union Water Power Company, Berlin Mills Company now the Brown Company), International Paper Company and the Rumford Falls Power Company—entered into an agreement whereby each of the companies purchased stock in the Androscoggin Reservoir Company equal to 25 per cent of the expense of organization and of construction of the new dam. The Union Water Power Company controls, through ownership of dam sites and dams, the stored water in six lakes forming a part of the storage system. The other three companies entered into an agreement with the Union Water Power Company whereby each of the four companies would pay its proportional share of the expenses of operation, maintenance and repairs on the storage systems controlled by the Union and Androscoggin companies.

In return for this agreement for the payment of proportional expenses on its systems, the Union company agreed to discharge from its reservoir system yearly two-thirds of the water necessary to maintain the flow of the Androscoggin River at Berlin, N. H., at not less than 1550 cu.ft. (42 cu.m.) per second, provided the amount of stored water in both systems allowed this. The Androscoggin company agreed to discharge from its reservoir one-third of the necessary amount of water yearly.

Mr. Sawyer states that the plan worked out at the time of the formation of the Androscoggin company has been very successful, and that it has been possible to maintain a flow at Berlin in excess of the minimum specified the greater part of the time. There are several opportunities for increased storage at the headwaters of the Androscoggin, and there is no doubt that these, with the possibilities for power, will be utilized in the not distant future.

Without the storage system, some of the water now saved would have been utilized, but of course the results are far more satisfactory with the storage. The saving of surplus in times of flood makes the water power far more even and valuable at low water.

The total storage above the Azisoohos dam amounts to 96,000,000,000 cu.ft. (283,000,000 cu.m.). The total cost of the dam, dike, flowage, etc., was about $1,000,000, or about $105 per 1,000,000 cu.ft. (28,000 cu.m.) of storage capacity.

BENJAMIN FRANKLIN AS A DAYLIGHT-SAVING ADVOCATE

America's Pioneer Electrician Discovered the Advantages of Earlier Rising in 1784—He Deplored Needless Waste of Wax and Tallow

DAYLIGHT saving is not a twentieth-century discovery. No less a man than Benjamin Franklin hit upon the idea 135 years ago during his stay in Paris. In March of 1784 he sent anonymously to the *Journal of Paris*, under the heading "An Economical Project," a *jeu d'esprit* worthy of Addison or Steele. This little serio-comic essay begins:

MESSIEURS: You often entertain us with accounts of new discoveries. Permit me to communicate to the public through your paper one that has lately been made by myself and which I conceive may be of great utility.

I was the other evening in a grand company where the new lamp of Messrs. Quinquet and Lange was introduced and much admired for its splendor; but a general inquiry was made whether the oil it consumed was not in exact proportion to the light it afforded, in which case there would be no saving in the use of it. No one present could satisfy us on that point, which all agreed ought to be known, it being a very desirable thing to lessen, if possible, the expense of lighting our apartments, when every other article of family expense was so much augmented. I was pleased to see this general concern for economy, for I love economy exceedingly.

I went home, and to bed, three or four hours after midnight, with my head full of the subject. An accidental sudden noise waked me about 6 in the morning, when I was surprised to find my room filled with light, and I imagined at first that a number of those lamps had been brought into it; but, rubbing my eyes, I perceived the light came in at the windows. I got up and looked out to see what might be the occasion of it, when I saw the sun just rising above the horizon, from whence he poured his rays plentifully into my chamber, my domestic having negligently omitted the preceding evening to close the shutters.

I looked at my watch, which goes very well, and found that it was but 6 o'clock; and, still thinking it something extraordinary that the sun should rise so early, I looked into the almanac, where I found it to be the hour given for his rising on that day. I looked forward, too, and found he was to rise still earlier every day till toward the end of June, and that at no time in the year he retarded his rising so long as till 8 o'clock.

Your readers who, with me, have never seen any signs of sunshine before noon, and seldom regard the astronomical part of the almanac, will be as much astonished as I was when they hear of his rising so early, and especially when I assure them that he gives light as soon as he rises. I am convinced of this. I am certain of my fact. One cannot be more certain of any fact. I saw it with my own eyes. And, having repeated this observation the three following mornings, I found always precisely the same result.

Yet it so happens that when I speak of this discovery to others I can easily perceive by their countenances, though they forbear expressing it in words, that they do not quite believe me. One, indeed, who is a learned natural philosopher has assured me that I must certainly be mistaken as to the circumstance of the light coming into my room; for it being well known that there could be no light abroad at that hour, it follows that none could enter from without, and that of consequence my windows, being accidentally left open, instead of letting in the light, had only served to let out the darkness; and he used many ingenious arguments to show me how I might by that means have been deceived. I owned that he puzzled me a little, but he did not satisfy me; and the subsequent observations I made, as above mentioned, confirmed me in my first opinion.

The event has given rise in my mind to several serious and important reflections. I considered that if I had not been awakened so early in the morning I should have slept six hours longer by the light of the sun, and in exchange have lived six hours the following night by candlelight; and, the latter being a much more expensive light than the former, my love of economy induced me to muster up what little arithmetic I am master of and to make some calculations which I shall give you, after observing that utility is, in my opinion, the test of value in matters of invention and that a discovery which can be applied to no use, or is not good for something, is good for nothing.

Taking as the basis of his calculations the supposition that there were in Paris a hundred thousand families which consumed in the night half a pound of candles per hour, Franklin then went into an elaborate calculation to show that, between March 20 and Sept. 20, 64,050,000 lb. of wax and tallow would be saved annually, equivalent in money value to 96,075,000 livres, or about $18,000,000. He then resumed:

If it should be said that people are apt to be obstinately attached to old customs, and that it will be difficult to induce them to rise before noon, consequently my discovery can be of little use, I answer, "Nil desperandum." I believe all who have common sense, as soon as they have learned from this paper that it is daylight when the sun rises, will contrive to rise with him.

To compel the rest to do so Franklin proposed: (1) a tax of a louis on every window that had shutters; (2) that no family should be allowed more than a pound of candles a week; (3) that no coaches should be allowed to pass after sunset, except those of physicians, surgeons and midwives; (4) that every morning as soon as the sun rose all the bells in every church should be set ringing, and if this was not sufficient, that cannons should be fired in every street "to wake the sluggards effectually and make them open their eyes to their true interest." He continued:

All the difficulty will be in the first two or three days, after which the reformation will be as natural and as easy as the present irregularity, for it is only the first step which costs. Oblige a man to rise at 4 in the morning, and it is more than probable that he will go willingly to bed at 8 in the evening, and, having had eight hours' sleep, he will rise more willingly at 4 in the morning following.

Much could be saved in the other half of the year also, the philosopher averred, and the immense stock of wax and tallow unconsumed during the summer would make candles much cheaper. In conclusion this pioneer would-be saver of daylight wrote:

For the great benefit of this discovery, thus freely communicated and bestowed by me on the public, I demand neither place, pension, exclusive privilege, nor any other regard whatever. I expect only to have the honor of it. And yet I know there are little, envious minds who will, as usual, deny me this and say that my invention was known to the ancients, and perhaps they may bring passages out of the old books in proof of it. I will not dispute with these people that the ancients knew not the sun would rise at certain hours; they possibly had, as we have, almanacs that predicted it; but it does not follow thence that they knew he gave light as soon as he rose. That is what I claim as my discovery. If the ancients knew it, it might have been long since forgotten; for it certainly was unknown to the moderns, at least to the Parisians, which to prove I need use but one plain simple argument. They are as well instructed, judicious and prudent a people as exist anywhere in the world, all professing, like myself, to be lovers of economy, and, from the many heavy taxes required from them by the necessities of the State, have surely an abundant reason to be economical. I say it is impossible that so sensible a people, under such circumstances, should have lived so long by the smoky, unwholesome and enormously expensive light of candles if they had really know that they might have had as much pure light of the sun for nothing.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

FIRST COST OF STEAM PLANTS USING SMALL-SIZED UNITS

Average Results for Selected Plants in Massachusetts Prove to Be Fairly Consistent, Although Data for Individual Stations Vary

The unit cost of a steam-electric plant, especially if it includes only the equipment and superstructures, will not show very great variations in ordinary locations. On the other hand, the cost of foundations, land, etc., may vary considerably owing to local conditions; but these do not, as a rule, greatly affect the total cost of the steam-electric station. Under normal conditions the cost of steam plants for units of 1000 kw. and over is between $80 and $90 per kilowatt. With very large units a lesser cost per kilowatt is usually possible. This total cost is made up normally of about $40 for steam plant, $30 for electric plant and $15 for power house, etc. The total annual fixed charges for a steam-electric plant are about 12 per cent of its first cost, interest usually being taken at 5 to 6 per cent, taxes and insurance at 1½ to 2 per cent, and depreciation at 4 to 5 per cent, based on construction cost.

TABLE I—FIRST COST OF SELECTED STEAM-ELECTRIC PLANTS IN MASSACHUSETTS (1914-17)

Year	Cost per Kw. Steam Plant	Electric Plant	Total
1914	$40.70	$28.40	$69.10
1915	42.50	28.00	70.50
1916	36.00	24.60	60.60
1917	40.00	30.00	70.00
Average.....	$39.80	$27.80	$67.60

* With cost of power and boiler houses included at $15 per kilowatt, the average cost of these plants would be $83 per kilowatt.

In the following table are given data of operating costs and amount of fuel used for the several central-station plants in Massachusetts for the years 1914-17, inclusive, previously referred to. With this pre-war cost of coal ($4) the total operating cost per kilowatt was about 0.88 cent, of which about 62 per cent represented fuel cost, 22 per cent wages and the remainder miscellaneous costs. No data are available as to the average load factor at these plants, but it is probably in the vicinity of 40 to 50 per cent.

TABLE II—OPERATING COSTS, ETC., AT SELECTED STEAM-ELECTRIC PLANTS IN MASSACHUSETTS (1914-17)

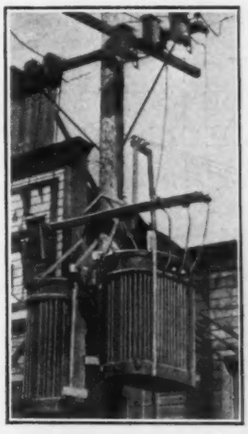
Cost of Coal per Ton of 2000 Lb.	Lb. of Coal per Kw. Made	Cost per Kw., Cents Coal	Wages	Miscellaneous	Total
$4.00 (as reported)	2.75	0.55	0.19	0.14	0.88
5.00	....	0.69	....	....	1.02
6.00	....	0.83	....	....	1.16
10.00	....	1.37	....	....	1.70

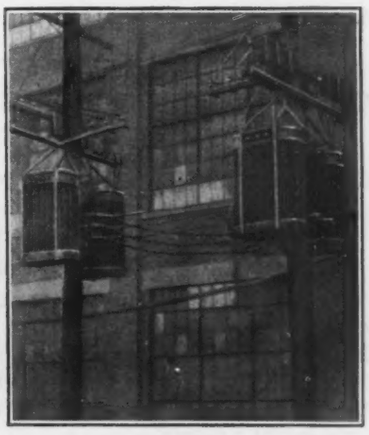
This information was given by H. K. Barrows in a water-power report presented to the Maine Public Service Commission and applies only to New England conditions for the years 1914 to 1917 inclusive.

TWO 150-KVA. TRANSFORMERS MOUNTED ON A SINGLE POLE

Utility Installed 300 Kva. in Distribution Transformer Capacity on One Pole to Save Expense—Method of Supporting Units

The installation of two 150-kva., three-phase, 60-cycle distribution transformers on one pole has enabled the Union Electric Light & Power Company, St. Louis, Mo., to save space and the expense of many substations, transformer vaults and additional poles on customers' premises. These double-transformer installations, ranging up to 300 kva. on a pole, have been found adaptable to almost any location. They are not unsightly, and they have been found to have the long life and low cost with the high factor of safety which are so essential in installations of this character. The Union company was a pioneer in hanging single transformers of this size on poles and was also probably the first utility to hang two of these units on the same pole. Transformers rated at 150 kva. weigh about 3500 lb. (1580 kg.) each, so a heavy pole is required to support them. For single installations of two such units a chestnut pole is usually selected at least 40 ft. (12.2 m.) long, with diameters of approximately 22 in. (56 cm.) at the base and 8 in. (20 cm.) at the top. All poles used for this purpose are set in concrete from the bottom of the pole to the surface of the street. Each transformer is hung from a set of three oak arms. The top and bottom arms are each 4 in. by 4 in. by 42 in. (10.1 cm. by 10.1 cm. by 106.6 cm.). The other arm is shorter, measuring 4 in.





FIGS. 1 AND 2—TWO 150-KVA. TRANSFORMERS ON ONE POLE; FOUR 150-KVA. TRANSFORMERS ON TWO POLES

In Fig. 1 note position of the oak arms, especially the short one directly under the upper long arm. In Fig. 2, where the four transformers serve one customer, note the V-braces which help support transformers.

by 4 in. by 12 in. (10.1 cm. by 10.1 cm. by 30.4 cm.). This short arm is bolted directly under the top supporting arm upon which the transformer hangers rest. The bottom arm serves as a second support to the top arm and in addition holds the bottom of the transformer the proper distance from the pole. Each arm is securely fastened through the pole with machine bolts of ⅝-in. (1.59-cm.) diameter. The top arm is so placed on the pole that the bottom of the transformer will always clear the ground line by 15 ft. (4.5 m.). As a safety measure, to give additional support to the transformer, a special V-shaped brace is hooked under the bottom flange of the transformer on the side farthest removed from the pole and fastened to the pole above. The brace is made of 0.5-in. by 3-in. (1.27-cm. by 7.6-cm.) wrought iron, and the necessary tension is obtained by the aid of a toggle which is bolted through the body of the pole above the transformer.

Each transformer is hoisted into position separately with the aid of a pair of 8-in. (20.3-cm.) three-sheave blocks, one of which is secured to the pole at a point approximately 10 ft. (3 m.) above the top of arm. The exact position of the block must be determined in each case by the height the transformer has to be raised. A 1.25-in. (3.2-cm.) sling is looped under the hoisting lugs of the transformer, and one end of the rope from the block is fastened to this sling. The other end of the rope is then secured to the rear of one of the line trucks, and by a series of short hitches the transformer is raised to the proper position and connected up in the usual way. The second transformer is mounted on the opposite side of the pole at a difference in elevation great enough to allow the bolts of each transformer to have sufficient clearance where they pass through the body of the pole. Customers are being furnished up to 600-kva. capacity from the 4000-volt lines of this company by installing in the street 150-kva. transformers on each of two poles, as shown in one of the illustrations.

ELECTRICITY SUPERSEDES STEAM FOR MAKING CELLULOID COMBS

With an Initial Installation of Five Hot Tables, One Company Increased Production 20 per Cent—Estimate $100 Saving per Month

There have been numerous applications of the electrically heated hot table, but one of the most important and most successful in every respect is its application to the working of celluloid in a comb factory. For such an application certain temperatures are required and varying degrees of heat are necessary for the various steps in the process.

The Ideal Comb Company plant in Lowell, Mass., with an initial installation for five electrically heated hot tables, increased its production about 20 per cent. This was due to the uniformity of the electric heat, which permitted a more economical working of the tables. This company estimated that operating the tables constantly at a moderate rate, except for a short period in the morning and another at noon when they were operated on high heat, it cost about 17 cents a day per table with a power rate of 10 cents for the first 20 kw.-hr. and 2 cents thereafter. On low heat it would cost 9 cents per day per table at this rate. By changing from steam to electric heat it has been estimated that there will result a net saving over the cost of the electric energy of $100 per month on wages of firemen and on coal.

Owing to the uniform heating of the electrically heated hot tables, the comb company found it possible to use 0.125-in. (0.32-mm.) celluloid stock on the electric hot table, while 0.140-in. (6.36-mm.) stock was the smallest that was possible with the steam table. This item is of considerable importance in a factory of any great production.

The tables, which are 1 in. by 16 in. by 24 in. (2.5 cm. by 40 cm. by 60 cm.), are normally rated at 1800 watts and 110 volts and are equipped with a three-heat snap-switch control. Each has six 300-watt steel-clad heaters installed under the steel-top plate, and the heaters are so connected as to take 1800 watts on high, 900 watts on medium and 450 watts on low heat.

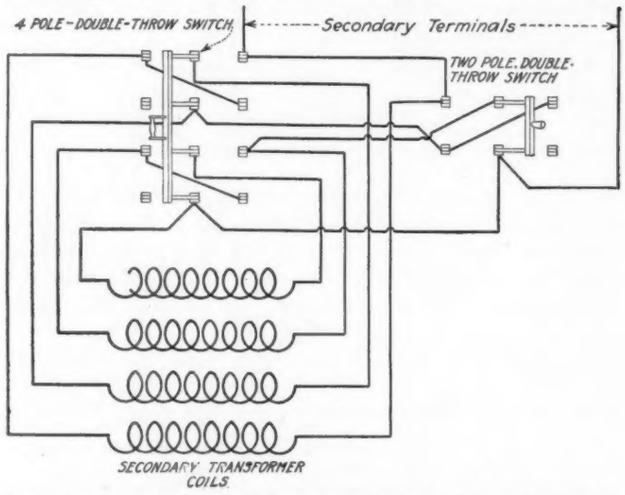
The foregoing information was contributed by John M. Strait, industrial heating section of the Westinghouse Electric & Manufacturing Company.

OBTAINING FULL RATING AT VARIOUS VOLTAGES

"Foolproof" Switching Arrangement That Permits Utilization of Full Rating and Makes Diagram of Position of Switches Unnecessary

BY CLARK POOL

Sometimes it is desirable to make a rapid change in the connections of a transformer so as to secure different voltages without greatly lowering the rating of the transformer. A "foolproof" arrangement of switches



POSITION OF SWITCH HANDLES INDICATES LOW, INTERMEDIATE OR HIGH VOLTAGE

which makes this possible is shown in the accompanying diagram. It is adapted for use with a transformer having four equal secondary coils which may be connected for three different voltages. This arrangement makes it possible to utilize the full rating of the transformer at any one of the three voltages. The entire switching equipment consists of one double-pole double-throw switch and one four-pole double-throw switch.

When the handles of the switches are pointing toward each other, all of the coils are in multiple, giving the lowest voltage; when the switches are pointing away from each other the coils are in series, thus affording the highest voltage. An intermediate voltage can be obtained in two ways by having the switch handles point in the same direction.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

DISPOSAL OF OBSOLETE AND SHOPWORN GOODS

Philadelphia Company Sells at Auction Restricted to Employees Articles That Could Not Be Sold to Regular Customers

Once or twice a year, according to the amount of goods on hand, the Philadelphia Electric Company holds an auction sale for the benefit of its employees. It is conducted in connection with the N. E. L. A. company section meeting. The articles which are sold by auction are either shopworn goods or else discarded or more or less obsolete types of electrical goods. Consequently they could not be sold to regular customers. Many of the parts cannot be supplied readily, and the goods are not so modern as other articles of the same kind that are on sale.

The articles vary from washing machines and carpet sweepers to toasters, broilers, hair curlers, lamps and lamp shades, flatirons, etc. The employees are told the exact condition of the articles and that they are discarded or obsolete types. All are in excellent repair, and where parts are missing, like cords, this fact also is stated.

No effort is made to get big prices or to obtain any profit; yet, in spite of this, some articles are sold at prices near the retail cost. Everything is done on a cash basis. Usually a hundred or more articles are placed on sale, and in most cases the bidding is spirited.

Frequently where a would-be buyer is unable to get some article and is a persistent bidder on others without result another article is awarded to him or her on the first bid. Every effort is made to dispose of the goods to as many buyers as possible. The sale is restricted to the employees of the company.

NEWSPAPER CREATION OF FAVORABLE PUBLIC OPINION

Example of Extent to Which Unsolicited Local Publication Will Go to Make Utility's Place in the Community Strong

Unsolicited editorials in the local newspapers making favorable comment on the local utility are even now sufficiently rare to be of interest. The following paragraphs from the Newburgh (N. Y.) *Daily News* of March 14 last are of this nature and serve to show to what extent a newspaper—the molder of public opinion—will go to create favorable public relations for the utility:

LOCAL EXAMPLE OF THE BEST KIND OF "PUBLIC" OWNERSHIP

The Central Hudson Gas & Electric Company, representing a consolidation of heat, light and power concerns of Newburgh, Poughkeepsie and nearby towns, is one of a long list of corporations which have adopted for their motto "The public be pleased." The Central Hudson company is one of the big assets of Newburgh and Poughkeepsie because it is prepared for every development in the large territory it serves. It is ready to meet any industrial, commercial or household need. It maintains a service which could not be improved upon and which is rarely if ever interrupted even temporarily in the event of accident or storm, owing to its emergency equipment and reserve.

The Central Hudson company serves business men and the people so well that its business is steadily increasing, necessitating betterments and extensions which are to be financed through an issue of $750,000 7 per cent convertible debenture bonds. The assets of this company are so large, its equipment in such splendid condition, its business so great and its prospects so promising that an offer by it of $750,000 bonds, bearing 7 per cent interest, to financial institutions and brokerage houses would be accepted on the instant. The company prefers, however, to distribute the bonds among home people—among its customers, the small as well as the large. To quote the company: "We believe in this city—that is why we have invested over a million dollars here to supply gas and electric service. We believe in the future of Newburgh (and Poughkeepsie)—that is why we are constantly adding to our investment here. But we want a greater community, more industries, more homes, more people, more prosperity. We believe we can and do help community development by being ready to serve, not alone the retail but the wholesale demand of present and prospective users for reliable gas and electric service at reasonable rates."

The company in its advertisements in the *News* has always taken the public into its confidence. It wants the public's interest and support. It believes, and rightly, that by making the public largely the owner of the company it will gain in business and good will. Already its consumers own a majority of its shares of stock.

COLLECTION, BILLING AND METER-READING ECONOMY

System of Machine Bookkeeping and Distributed Discount Period Found to Work Out Very Satisfactorily for Small Property

BY R. J. HOLE
General Manager North Carolina Public Service Company, Greensboro, N. C.

In the old days—that is, prior to July, 1918—meter reading was not any employee's specific work, and all of our reading was done by five or six of the men from the gas and electric departments during the last eight days of each month. During this period of the month all but the most pressing work in the operating departments was neglected, and as a result it would take almost to the next meter-reading period for these departments to get "caught up" again. Furthermore, as the men were inclined to be careless in their reading, we had a good many over and under readings and an unusually large number of "skips" each month. Besides, it seemed to be the ambition of the majority of the readers to keep the daily average of readings down around 100 per man.

This method of reading meters, together with the conditions under which the meters were read, placed a

very heavy burden on the office force at the end of each month. The two bookkeepers, who kept the customers' records in Boston ledgers, were snowed under with work in extending meter readings, making out bills, posting ledgers and ledger cards, and posting credits; and, notwithstanding hours of overtime each day, they were compelled to call on several other clerks for assistance. As all of the bills were usually ready for mailing not later than the first of the following month, the bookkeepers were forced to begin work at once taking off a trial balance, after which other statistical information, such as kilowatt-hour and cubic feet consumption of gas, was compiled. This work occupied from six to eight days and of course did not leave any time to the bookkeepers for recording cash postings, which on account of the discount period were very heavy during the first ten days of each month. Nor did they have time to make a daily record of new consumers and disconnections. All of the regular routine work was neglected during meter-reading and trial-balance periods.

The Elliot-Fisher bookkeeping and billing machine, together with daily meter readings, was the combination decided upon as a solution of our troubles, and after six months' operation we feel well satisfied with the combination.

A man to be a competent meter reader must be accurate and steady, and we therefore picked from our force a man thought to have these qualifications. This man reads all of our gas and electric meters, with the exception of the gas pre-pay meters, between the fifth and last of each month. The readings he turns in are practically 100 per cent correct, and "skips" are virtually things of the past. The meter reader, if he notices anything peculiar about the reading, whether it is extremely high or extremely low, notes same on his meter-reading book, after his reading, and it is a sign to the billing clerk that he has investigated the matter in so far as he can and that his reading is correct.

The meter-reading slips for each day are placed the next morning on a clerk's desk to be extended; after this operation, which does not take over a couple of hours daily, the slips are turned over to the bookkeeping and billing-machine operator, who at one operation makes out the customer's bill, posts the customer's ledger card and fills in the abstract sheet. As the machine will not clear itself if any figures have been recorded incorrectly, the chances for mistakes are virtually eliminated. The operator checks the bill clerk, who in turn checks the meter reader. If there is anything peculiar about the bill, such as high consumption in gas or electricity, or the opposite, this peculiarity is bound to be noticed by one of these three employees and the matter investigated before making out the bill.

Cash receipts for each day are posted the next day, the total on the abstract sheet proving up with the cashier's total for the day posted.

The machine gives us not only a daily balance on the customer's ledger, but we know at the end of each day what our total sales for the previous day amount to, also the total sales for the month to date. This total is further subdivided to show the revenue accruing from the kilowatt-hours sold for the commercial lighting, power and flat rates, also the revenue from the gas sales. In addition to all this, the register gathers the total kilowatt-hours sold according to classes of service; also the total cubic feet of gas sold. As a result of all this, each day's work is completed as we go along.

There is no congestion at any one period of the month. All our work is now evenly distributed over all working days of each month. This also means a discount period expiring each day, because each bill is stamped the day it is sent out and the discount period extends from this date for ten days. The cashier is busy all the time but never rushed to the point where it is necessary to get assistance. Our collector is aided to the extent that he can give more personal attention to the few delinquents discovered each day than he formerly could when a list of the delinquents had to be taken off at the end of each month, the list sometimes running up into hundreds. This fact alone reduces our bad debts and adds thousands of dollars to the sum total of collections each month.

We first installed one bookkeeping and billing machine, thinking that we could do the billing during the day and the cash posting at night. We soon found, however, this was unsatisfactory, whereupon we ordered another machine and did the cash posting the following day, and at the same time bought all the necessary stationery, etc., for handling our sundry ledger, so that this installation has practically taken our entire system from hand operation to machine operation. We find that with these machines the accuracy of our accounting department is greatly improved.

AN ACTIVE DEMAND FOR RANGES IN NORTHWEST

Contractors Reduce Number of Outlets to Cut High Wiring Costs, Thereby Hampering Appliance Market

Some interesting sidelights on the central-station commercial situation were given to a representative of the ELECTRICAL WORLD recently by A. C. McMicken, commercial manager of the Portland (Ore.) Railway, Light & Power Company. His experience indicates a very rapid increase during the past year or two in the demand for socket devices. Last year, for example, the Portland company made no sales effort whatsoever on electric ranges owing to power shortage, war-load urgency, lack of funds for extending business, etc. Nevertheless, 110 ranges were sold in the company's salesroom, which is merely a display space in the room where bills are paid. Besides, 350 applications for electric range service were refused because the installation would require a transformer or something more than the extremely short extension which the company was willing to make.

There is considerable business in sight in Portland when conditions are such that the company can see its way clear to go after it.

It was pointed out by Mr. McMicken that the sale of household appliances is being very seriously retarded by the lack of convenient outlets. Women give up the idea of purchasing a vacuum cleaner, for example, because of the inconvenience of climbing upon a chair to connect and disconnect each room.

The high costs of war times, Mr. McMicken stated, have served to decrease the average number of outlets, and the contractor, who does not suffer from the same difficulty in the matter as does the power company, is quite willing to meet more nearly the customer's idea of a reasonable cost on the wiring job by cutting down the number of outlets.

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Reconnecting Induction Motors.—A. M. DUDLEY.—During the last two years a series of thirteen articles have appeared in *Power* on the subject of reconnecting induction motors. The purpose of the present article is to sum up the principles brought out in the series and to give an outline of the practical points that must be considered in deciding whether or not a given motor may be reconnected for different conditions without new coils or core iron.—*Power*, March 18, 1919.

Adapting and Standardizing Motor Drives. — E. ADLER.—Standardization of motor drives is in the interests of manufacturers and consumers, provided that the needs of individual loads can be met. Two types of motor may be distinguished, namely special motors built to utilize the full requirements of the driven machines and normal motors built to suit as wide a field as possible. A small number of "special" motors may be made from modified "normal" components; if, however, many of the former are required, it pays to build special lines of machines. The following recommendations are made: Small motors should be capable of plug connection; from this point of view 110 or 220 volts direct current or single-phase alternating current is most convenient. Three-phase yields favorable characteristics, but the necessity for three leads, the possibility of reversed rotation and the impossibility of connecting to lighting circuits are disadvantages. If one small "universal" motor cannot be provided for both direct-current and alternating-current operation, small machines for both kinds of current should at least have equal power, r. p. m. and main dimensions. Voltages might be standardized with great advantage. In networks with abnormal frequency the voltage should be chosen so that 50-cycle, normal-voltage motors can be utilized.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Elekt. Zeits.*, Sept. 26, 1918.)

Electric Machinery Built of Low-Conductivity Metals.—J. ROTHBAUER.—A comparison is made of the dimensions, output and losses of a generator and a motor, it being supposed that the windings are (1) of copper, (2) of aluminum, or (3) of zinc.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Electrot. u. Maschinenbau*, Sept. 29, Oct. 6 and Oct. 13, 1918.)

Generation, Transmission and Distribution

Study of Conditions on Line Traversed by Sinusoidal Current.—E. BRYLINSKI.—In this paper, presented before the Société Française des Electriciens, approximate formulas designed to give quickly the value of the unknown quantities in alternating-current transmission at the moment of the establishment of a project are given. For example, by them one would be able to determine the voltage E_1 at the end of a line knowing the voltage V_1 at the generator and the apparent power P_a at load; or, again, one could ascertain the maximum of energy that could be transmitted with a given generator voltage V_1. The author shows that the numerical results that are arrived at with complete formulas differ little from those attained by his approximate ones.—*Revue Générale de l'Electricité*, March 1, 1919.

Utilizing Waste Heat.—A discussion of the utilization of waste heat rejected in the exhaust of steam and other engines.—London *Times Engineering Supplement*, February, 1919.

Large Turbo Units.—It is suggested that units of 25,000 kw. or possibly 50,000 kw. will be used in the proposed national power scheme in Great Britain. Up to the present time it is said that there are no 25,000-kw. units in Great Britain, although one had been built of that size for use in America. It is pointed out that such units are economical in steam consumption, first cost per kilowatt, floor space and attendance. Problems of cylinder arrangement and lighting are outlined by the writer.—London *Times Engineering Supplement*, February, 1919.

Water-Power Questions in Sweden.—At a meeting of the Swedish Water Power Association in April, 1918, Sven Lübeck reported that, despite the enormously increased cost of labor and machinery and the financial risks connected therewith, private enterprise in the sphere has increased rather than diminished during the past year. He stated that the high prices of materials have caused a certain change, where circumstances permitted, from iron to reinforced concrete and from concrete to masonry. It was said that the whole utilization of water power in Sweden now amounts to 1,000,000 hp.—*Swedish Export*, November, 1918.

Traction

Car-Lighting Regulator Testing Equipment.—B. H. EHRINGER.—In the past methods of testing and inspecting car-lighting outfits have required that the tester spend a considerable amount of time riding on the cars making his tests and repairs en route. Other companies have driven the car-lighting sets by means of special motors while the cars were standing in the yards. These various methods, however, have been too expensive in that the services of several men were required. Recently a testing outfit has been developed for the New York Central at its passenger car yard in Chicago. In this method the regulating panel is disconnected in the car and taken into the testing room, where it is inspected and tested according to certain requirements laid down by the electrical engineer. This method has been found economical and satisfactory.—*Railway Electrical Engineer*, February, 1919.

High-Power Electric Locomotives for Narrow-Gage Goods Trains.—Some interesting particulars of the high-powered electric locomotive employed on the railways at Bernina, Switzerland, have been furnished by

Messrs. Brown, Boveri & Company. The conditions on these railways are extremely exacting, necessitating 800 hp. per locomotive. The railway works with a 1-m. gage, the curves are pronounced, and the gradient in parts exceptionally steep. Mechanical and electrical details of the locomotive are featured.—London *Electrician*, Feb. 21, 1919.

Railroad Electrification Facts and Factors.—A. J. MANSON.—In this article there appears a comparison between steam and electric locomotives, as analyzed by electrical engineers, showing the superiority of the electric locomotive over the steam locomotive for general railway service. Charts are presented indicating the relative tractive efforts and horsepower developed by steam and electric locomotives for various speeds. A table showing the results of such comparisons for equal weights follows:

Characteristics	Steam 4-8-2	Electric 4-6-2 2-6-4
Weight—Engine and 14-ton tender	268.5 tons	266 tons
Weight—Engine only	352,000 lb.	532,000 lb.
Weight—Engine on drivers	243,000 lb.	330,000 lb.
Number of pairs of drivers	4	6
Weight per pair	60,500 lb.	55,000 lb.
Wheel diameter, inches	69	68
Total wheel base engine and tender	75 ft. 8.5 in.	79 ft. 10 in.
Maximum tractive effort	58,000	110,000
Maximum horsepower	2,825	5,860
Continuous horsepower	2,825	3,200

—*Railway Electrical Engineer*, February, 1919.

Fuel-Oil Saving in Railway Electrification.—The United States Fuel Administration during its régime in California recommended the electrification of certain of the mountain sections of the railways of that state, with the object of saving fuel oil. Although this was proposed as a war measure, the data are now at hand for peace-time purposes and serve as an indication of the possibilities of electrification from a financial as well as a technical standpoint.—*Journal of Electricity*, March 1, 1919.

Installations, Systems and Appliances

Electricity in French Agriculture.—A. DELAMAIRE.—A description of the methods used in applying electricity to farm labor in the region of Meaux, France, where such cultivation has been developed by the local electrical corporation in coöperation with a government commission and national agricultural and electrical societies. Two metallic transforming substations mounted on wagons step down 15,000-volt, three-phase energy taken from the company's transmission lines to 750 volts and, by means of a flexible cable, drive two windlasses and two balancing harrows. To reach fields at a distance from the network material for extension lines 3 km. in length is provided. These lines are carried upon ordinary poles set only 0.6 m. in the soil and have steel conductors of 7 sq.mm. section. The poles are set 100 m. apart.—*Revue Générale de l'Electricité*, Feb. 22, 1919.

Harrington Forced-Blast Traveling Grate. — There has been a widespread demand on the part of power-plant designers for an automatic stoker that can be forced to a point of capacity far in excess of the limits of natural draft. Certain conditions, however, must be complied with before such application can be considered as commercially successful. These are as follows: (1) The stoker must allow the fuel to remain quiet during the combustion period to avoid clinkers. (2) To avoid the accumulation of refuse in the furnace ash must be discharged as it is formed. (3) There must be no air spaces that are not periodically cleaned in the course of the automatic operation. (4) It is desirable that the stoker be divided into compartments in such a manner that the air pressure and volume in each compartment are suited to the requirements of fuel passing. (5) The stoker must be readily convertible to the natural-draft type during the low-load periods. (6) Parts subjected to the heat and fusing action of direct-fuel contact must be readily replaceable.—*Power*, March 11, 1919.

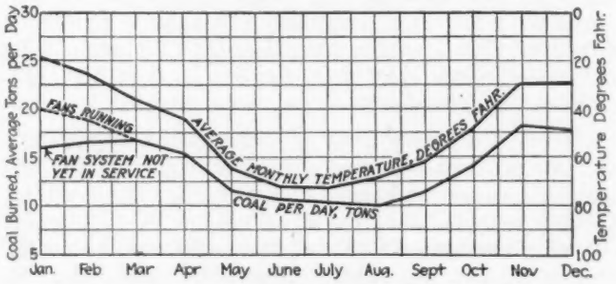
Mechanical Equipment of Industrial Buildings.—CHARLES L. HUBBARD.—This is the second installment of a series of articles on the subject of the equipment of industrial buildings. In this installment are considered the methods of electrical distribution, the selection of the electric motors and the types of variable-speed motors available.—*Power*, March 11, 1919.

Autogenous Welding.—In a paper given before the Institution of Mechanical Engineers Thomas T. Heaton dealt with electric welding processes chiefly as applied to mild steel. Particular attention is given to the methods of testing welds.—London *Times Engineering Supplement*, February, 1919.

Lifting Magnets.—A discussion of the construction, design and use of lifting magnets in industrial operations. It is pointed out that the great advantage of the lifting magnet over other cranes lies in the speed of performing the work inasmuch as no tying or fastening is necessary. The writer states that the energy consumption of such a crane is a small matter as compared to the saving inherent in its rapid action.—London *Times Engineering Supplement*, February, 1919.

Electrical Equipment of New Flour Mill.—A flour mill which is very completely equipped with electrical conveying, elevator and rolling machinery and is situated in the midst of the wheat country at Pasco, Wash., is described.—*Electrical Review*, Feb. 22, 1919.

Central-Station Heating.—JOHN C. WHITE.—Some of the possible economies that may be effected through the wider use of central heating stations are discussed in



CURVES SHOWING RELATION BETWEEN FUEL BURNED AND TEMPERATURES, WISCONSIN CAPITOL PLANT

this paper. There also appear cost data and results obtained with such plants for comparison with other types. It is held to be important to select the proper location for such a heating plant and recommended that more permanent construction should be used and that all consumers be put on meter rates. The economical use of the steam machinery in correlation to the load conditions is also discussed.—*Technical Paper No. 191, Bureau of Mines.*

Central Fire-Alarm Station of San Francisco.—In order to prevent the recurrence of a serious fire such as

that of 1906 every precaution is taken to make the fire-alarm system of San Francisco effective. Special provision is made to insure reliability of the power supply by careful design and interchangeability of circuits.—*Electrical Review*, Feb. 22, 1919.

Electric Arc Welding.—F. A. ANDERSON.—It is said that the development of arc welding has possibilities which have already greatly modified shipbuilding and promise further developments. The present article is the beginning of a series on the general subject of arc welding.—*Journal of Electricity*, March 1, 1919.

Electrophysics and Magnetism

Simple Method of Determining Complete Hysteresis Loops.—M. SCHLEICHER.—A simple method is described for the point-by-point determination of complete hysteresis loops by a ring method, using direct current. The method is compared with others as regards convenience and accuracy. It was devised originally for application to materials not available in thin bars as required for Koepsel's method. Among the advantages claimed are that a minimum number of instruments have to be read, the independent determination and repetition of each point, and the simplicity and good utilization of galvanometer sensitivity. A loop with thirty plotted points can be taken in twenty minutes.—*Science Abstracts, Section B*, Jan. 31. (Abstracted from *Elekt. Zeits.*, Oct. 3, 1918.)

An Electrolytic Method of Determining the Electric Field Round an Insulator.—W. ESTORFF.—The method of exploring the electric field of an insulator was made by the author, who immersed the electrode in an electrolyte in a manner similar to that employed by Fortescue and Farnsworth. Instead of using direct current, however, he applied alternating potentials to avoid any polarization effects and determined the equipotential surfaces from which may be derived the critical field densities. The equipotential surfaces surrounding a string of insulators as determined by the author's method are shown.—London *Electrician*, Feb. 14, 1919.

Electrochemistry and Batteries

Resistance of an Electrolytic Cell.—EDGAR NEWBERY.—The author states that the resistance of an electrolytic cell is made up of two parts, the resistance of the electrolyte and the resistance of transfer from electrode to electrolyte. Comparatively little attention has been given to transfer resistance. The author finds that it is a variable quantity even when the current density is constant, being greatly affected by the previous treatment of the electrodes, the temperature and the presence of colloids. The paper contains a study of this transfer resistance, more especially at the higher current densities.—London *Electrician*, Feb. 14, 1919.

Units, Measurements and Instruments

Using a Gas Jet in Obtaining Graphic Records.—L. LUMIÈRE.—To obviate the imperfections in graphic records caused by the rubbing of the stylus upon the paper the author uses a tube of very small diameter made of aluminum, or a straw covered with varnish or collodion, and terminating in a point bent to meet the paper. Then by employing vapor from a gas jet to react chemically upon specially prepared paper he claims to have arrived at a method of inscription so accurate that it could be used to record messages sent by submarine cable.—*Revue Générale de l'Electricité*, March 1, 1919. (Abstracted from *Comptes Rendus*, Dec. 30, 1918.

Miscellaneous

Study of Municipal Electric Lighting.—The article consists of a study of a report by E. E. Lincoln entitled "The Results of Municipal Electric Lighting in Massachusetts." From his preliminary surveys Mr. Lincoln draws the conclusion that the public plants, situated for the most part in the smaller municipalities, constitute more than 30 per cent of the total number of central stations in Massachusetts, represent about 3 per cent of the total assets and put out about 7 per cent of the energy (4.3 per cent of the assets and 5.4 per cent of the output if the hydroelectric companies are included). But he also says that practically no underground construction has been installed by the public plants, whereas even in 1911 50 per cent of the value of the distributing system of the private plants was accounted for by the underground lines and conduits, and at the same time 40 per cent of the total investment of the companies was in their distributing systems. Finally, the plant accounts as carried by the municipalities have been constantly written off each year for depreciation, at the rate of 3 per cent until 1907, and at the rate of 3 per cent in most cases since that date. Their plant accounts when compared with those of private plants will appear unduly large.—*Stone & Webster Journal*, February, 1919.

Extinguishing and Preventing Oil and Gas Fires.—C. P. BOWIE.—The bulletin aims to point out what has been done by operators in the past and to describe various fire-prevention methods and fire-fighting apparatus which are being used or adopted by many of the larger oil companies. These methods and apparatus, it is believed, if universally employed by operators, will largely decrease the present enormous annual losses. The subject is taken up from the point of view of the large oil-tank owners, but it is possible that some of the methods suggested for fire prevention might be applied to oil tanks of smaller capacities, such as those used by the central-station companies.—*Bulletin No. 170, Bureau of Mines.*

Inflammability of Aluminum Dust.—ALAN LEIGHTON.—Aluminum dust burns quietly when in a pile, but if this pile be disturbed in such a manner as to raise a cloud of dust into the air the burning takes place with explosive violence. If a dust cloud already formed that has a density within the explosive limits be ignited, a violent explosion results. In this article the physical and chemical properties of aluminum dust have been studied with regard to inflammability and the extinction of fires.—*Technical Paper No. 152, Bureau of Mines.*

The Magneto Industry.—It is said that before the war British motor engineers were dependent on Germany for the complete magneto machines, and they also had to look to that country and the United States for the supplies of practically all the raw materials used in the construction of these machines. The home industries, however, set about the task of making the insulating material, enameled wire and magnet steel, so that these as now produced in England are said to be even better in quality than those which had been imported from Germany. The plant of the Thomson-Bennett Works, Birmingham, is described in detail as a typical factory engaged in magneto manufacture.—London *Engineer*, Jan. 10, 1919.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

CONVENTION ARRANGEMENTS OF N. E. L. A. NEAR COMPLETION

Officers Now at Work Perfecting the Program, and the General Plans for Various Meetings Have Been Decided Upon

The National Electric Light Association has sent out to all of its members a circular letter containing general information on its forty-second convention, to be held at Atlantic City, N. J., May 19-22. As previously stated, the headquarters of the association will be on the Million-Dollar Pier, adjacent to all the hotels likely to be patronized by the members during the convention, and all the various departments—registration, hotel, transportation, executive, papers, membership sections, etc. —will have offices there also. All of the general sessions of the convention, most of the section sessions and practically all of the official entertainments will be held on the pier. An unusually fine and large exhibit of modern electrical apparatus and supplies, supplemented by a special exhibit under the auspices of the lamp committee, has been arranged for, as announced in these columns last week.

In view of the excellent train service that exists between New York and Atlantic City, no special trains will be arranged for from New York City or from the New England Section. A special train will be run, however, from Chicago over the Pennsylvania lines. This will leave Chicago on the morning of May 18 and run as a second section to the Manhattan limited. Reservations for this train should be made through Fred R. Jenkins, 72 West Adams Street, Chicago.

As now planned, the mornings of Tuesday, Wednesday and Thursday, May 20, 21 and 22, will be devoted to general sessions, while the afternoons of Tuesday and Wednesday will be allotted to sessions of the four national special sections. The exhibition will be open for inspection on the morning of May 19, and the general reception of the president will take place on the evening of that day. The first business session of the convention will begin at 10 o'clock on Tuesday, May 20.

CONNECTICUT WILL NOT HAMPER POWER EXPORTATION

Bill to Restrict the Sale of the State's Hydroelectric Energy Reported on Unfavorably by Committee.

A movement to limit the exportation of hydroelectric energy from Connecticut appears destined to failure. Last week the legislative committee on the judiciary gave a hearing upon a bill providing that any company desiring to sell more than 500 hp. of electrical energy generated by water power within the state to customers outside Connecticut must obtain permission from the Public Utilities Commission before making such sale, and that such permission should be granted only in case it was shown by the company at a public hearing that the interests of users of electrical energy within the state would benefit thereby.

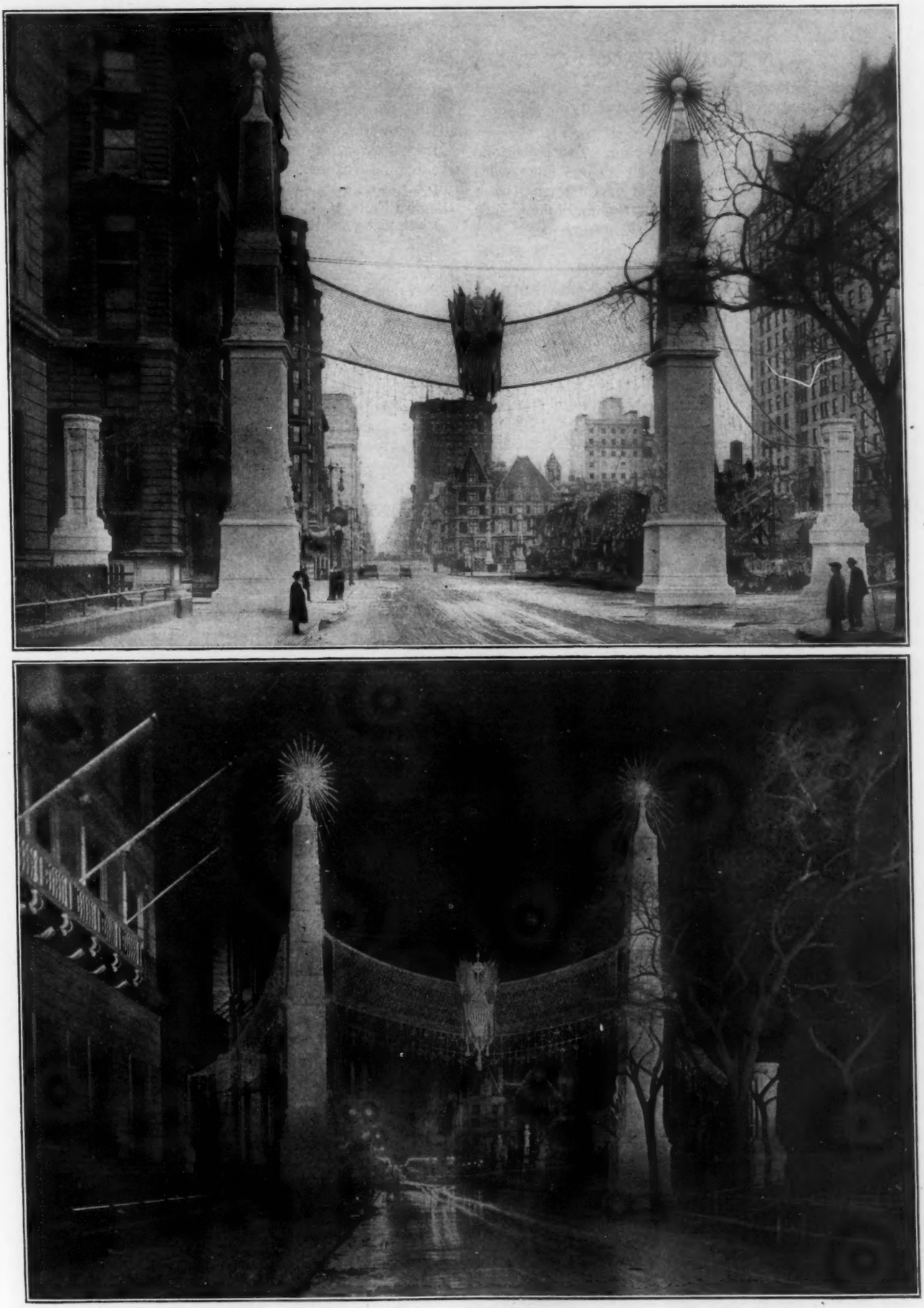
The bill provided for a yearly jurisdiction of the matter by the commission and forbade making a contract for energy delivery in excess of one year under the above conditions. No general support of the measure was in evidence, although it is much less drastic than the Maine law prohibiting the exportation of hydroelectric energy. Interconnection between Connecticut, Massachusetts and Rhode Island transmission and central-station systems is becoming a well-established practice, and the engineering and economic advantages of energy interchange appear to be widely recognized in Connecticut. The committee reported adversely on the measure soon after the hearing, and Senator Hemenway of the committee informed a representative of the ELECTRICAL WORLD that the bill will not be likely to pass at this session.

NEW YORK'S JEWELED PORTAL FOR THE VICTORIOUS ARMY

Superb Piece of Decorative Lighting, Emblematic of Light, Life and Purity, Erected for Homecoming Regiments

What is considered by many to be the most superb piece of decorative lighting in the history of the art, surpassing any individual effort made at the Panama-Pacific International Exposition, has been erected at the corner of Fifth Avenue and Sixtieth Street, New York City, in honor of the homecoming regiments. This jeweled portal was created in the illuminating engineering laboratory of the General Electric Company at Schenectady under the direction of Walter D'Arcy Ryan. The architecture and decorative features were executed by J. W. Gossley, chief of the art department, and the installation of the jewels, location of searchlamps and operation were handled by the Tucker Electrical Construction Company under the direction of Clarence L. Law, illuminating engineer of the New York Edison Company and secretary of the illumination committee appointed by the Mayor's committee on celebration to the homecoming troops.

Day and night views of the arch are shown on the opposite page. The arch is really a gigantic curtain of jewels draped between two obelisk forms. The obelisks rise to a total height of 80 ft. (24 m.) and are surmounted by great jeweled forms in the shape of sunbursts 12 ft. (3.6 m.) wide and 20 ft. (6 m.) high. Approximately 30,000 jewels from the famous Tower of Jewels of the Panama-Pacific International Exposition are used in the gigantic curtain, and when in use beams of light from arc projectors are thrown on the arch, causing the thousands of jewels to flash the brilliant and pure colors of the spectrum. The arch was designed especially for the purpose of jeweled decoration by W. D'A. Ryan, and the effect is most gorgeous.



New York City's Jeweled Portal for the Victorious Army

DAYLIGHT SAVING SPURNED IN DOMINION OF CANADA

Objections Made by the Farmers Cause the House of Commons to Reject Measure by a Large Majority

Canada has spurned daylight saving. The objections of the farmers to advancing the clocks one hour were sustained so firmly that the House of Commons, by a vote of 105 to 50, decided to kill the daylight-saving act for 1919. The fight was not led by any party, and representatives of the urban communities were generally arrayed against those of the rural districts.

It appeared from the speeches of the spokesmen of the farmers that the daylight-saving act made it necessary for argiculturists seeking to place their milk on trains or to get their products to market to rise in the darkness as in winter, and an hour earlier than usual. Furthermore, it seemed that although the farmer himself might be prepared to ignore the daylight-saving act and work from daylight to dark, the hired man preferred to act in accordance with the law. Thus, it was argued, the farmer lost the labor of his employee for an hour at the time of day best suited for the performance of certain farm tasks.

Other general objections that were raised were:

1. Farmers would be forced to begin milking operations between 3 and 4 o'clock in the morning, and the women on the farm would have to cook two breakfasts.
2. Owing to the dew of early morning it would be impossible for the farmers to hoe certain crops, such as beans and sugarbeets.
3. The passage of the measure would increase bitter feeling between rural and urban communities.

One angle of the situation discussed briefly was the matter of varying time near the border and the problems that would be caused in train schedules. Some members urged the border sections to adopt the same time as the United States, while others expressed the opinion that matters would be adjusted easily.

At a hearing given April 1 by the Dominion Railway Commission representatives of the Canadian railways and Railway War Board presented reasons for the adoption by Canadian roads of the daylight-saving system now in effect in the United States, despite the fact that the Dominion government has not authorized it.

The witnesses concurred in declaring that the daylight-saving plan would have to be continued on Canadian roads if connections with the United States were to be maintained, as the running of trains on different schedules would constitute a "dangerous experiment" and pile up difficulties in international traffic.

TO PROMOTE UTILIZATION OF ELECTRIC FURNACE PRODUCTS

Organization Formed for the Purpose of Disseminating Data on Electric Furnace Products of All Kinds

Steps were taken to promote the use of various electric furnace products at a meeting called by Acheson Smith, vice-president and general manager of the Acheson Graphite Company, held at Niagara Falls on March 21 and 22.

The meeting passed resolutions inviting all manufacturers of electric furnaces, electrical apparatus and electric furnace supplies and accessories, public utility corporations, designers and inventors of electric furnace equipment and the users of electric furnaces to become members and to join in a campaign to disseminate to engineers and to the public data as to the quality of electric furnace products of all kinds.

The organization formed is to be called the Electric Furnace Association. A permanent organization was created as follows:

President—Acheson Smith, Acheson Graphite Company, Niagara Falls, N. Y.

First vice-president—C. H. Booth, Booth-Hall Company, Chicago.

Second vice-president—W. E. Moore, Pittsburgh Electric Furnace Company, Pittsburgh, Pa.

Secretary—C. G. Schluederberg, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

Treasurer—F. J. Ryan, American Metallurgical Corporation, Philadelphia.

Directors—The officers and C. A. Winder, General Electric Company, Schenectady, and F. J. Tone, Carborundum Company, Niagara Falls.

The president was authorized to get in touch with all who should be interested in joining the organization and was requested to arrange an early meeting when completed publicity plans could be presented. In the meantime different committees were instructed to perfect reports as a basis for constructive work.

NEEDLESS APPREHENSION OF WATER-POWER CONTROL

Chairman Weed of Massachusetts Commission Defends Program and Says No User Is Under the Heel of Any Power Monopoly

Chairman A. R. Weed of the Massachusetts Gas and Electric Light Commission told the legislative committee on waterways and terminals at a hearing this week that the opposition to the proposed conservation program as set forth in the recent special report of the recess commission on water resources appears to be based upon needless apprehension of monopolistic control. At the last hearing representatives of the Holyoke Water Power Company and other concerns expressed the fear that if the coöperative conservation program should be sanctioned by the Legislature, the New England Power Company and Turners Falls Power & Electric Company might acquire a monopolistic hold upon the privileges on the middle Connecticut River and its tributaries. In the ELECTRICAL WORLD of March 29, page 651, an account was given of the attitude of President H. I. Harriman of the New England Power Company with respect to the proposed legislation, with a résumé of Chairman Weed's outline of the proposed conservation plan.

At the final hearing on Tuesday Mr. Weed replied to the objections urged at last week's hearing. He pointed out that the plan suggested resembles those of the Wisconsin Valley and Chippewa improvement and control projects, which are working out most successfully. State development is not advocated in the Massachusetts plan, but since the state has the right to assess the cost of storage improvements upon the owners of riparian rights, there is no question that a corporation of the state's creation has this right also. The public is vitally interested in the preservation and use of this great natural resource. Regarding claims of monopoly, Mr. Weed said that the Holyoke Water Power Company had thrived for seven years on the tribute it has exacted from the industrial life of the

Trying to Do the Impossible

The latent power in our streams must and will be used, and any means to thwart it are useless

community. He pointed out that power cannot be sold in large blocks except on a competitive basis.

"No user of 100 hp. or over," said Mr. Weed, "is under the heel of any power monopoly in any part of this state. Any man who sells power to such a user must base his rates upon the purchaser's cost of producing energy. If that is monopoly, then I don't know what monopoly is! We are a long way from the point where any manufacturer or any community is under the heel of any monopoly in the purchase of power, and I speak from some knowledge of such affairs." Mr. Weed said that he appreciated that the numerous and varied interests on the Millers River are naturally anxious to learn how the cost of storage would be apportioned among them. These interests are more complex, probably, than on any other stream in the state. In the proposed plan the commission would pass upon the creation of any storage on the coöperative basis. By the provision that no such plan could go through without the consent of a majority both in interest (proportioned to head developed) and in number the interests of the small power user would be protected.

W. Rodman Peabody, for the Turners Falls Power & Electric Company, vigorously denied that there was any community of interest or interlocking control between the Turners Falls and New England Power companies, with the single exception of the coöperative storage program on the upper Connecticut River, in which the two concerns share through the Connecticut River Conservation Company. He proposed an amendment to the act which would give the commission increased authority with respect to fixing benefits and tolls for storage secured. Mr. Peabody said that the success of the Connecticut River Conservation Company had led the Cabot interests, with others, to take up storage work on some of the tributaries of the Connecticut River. The only object of the Cabot interests in this work is to increase the summer flow of the Connecticut River at Turners Falls, thus raising the output of hydroelectric energy at the Montague City and other water-power installations.

Charles T. Main, consulting engineer, Boston, and a member of the special water resources commission, said that the cost of storage has hitherto been an abstacle to its development in many cases. Rather than forego the benefits of storage, Mr. Main thought that the state might properly assist in financing abnormal costs, if the flowage to be secured seems to justify this policy. The speaker quoted from the preliminary report of the Water Power Commission of the Conjoint Board of Scientific Societies, published in July, 1918—Sir Dugald Clerk, chairman, and A. H. Gibson, secretary—to show the interest in hydroelectric possibilities now manifested abroad in connection with reconstruction efforts. State assistance in financing such powers was recommended in this report, which suggested that the state might guarantee a suitable minimum rate of interest sufficient to attract private capital, sharing with the latter in the returns above the minimum rate.

Nathan Avery, for the Holyoke Water Power Company, stated that if a provision were inserted in the proposed act to the effect that no tolls shall be assessed on any water rights user in excess of the benefits which he will derive from the conservation program, he would withdraw his opposition. John N. Cole, chairman of the Massachusetts Waterways Board, also spoke, urging water-power conservation through storage development and likening the holders of riparian rights who "sit tight" without developing them to the slothful steward who buried his talent in the earth. He pointed out that New England vitally needs water-power development along still broader lines in order to compete with other sections of the country in manufacturing.

MASSACHUSETTS COMMISSION IS OVERRULED ON TELEPHONE RATES

Full Bench of Massachusetts Supreme Court Rules that the Postmaster-General Can Fix Telephone Toll Rate

The Supreme Court of Massachusetts handed down a decision by the full bench March 22 against the Public Service Commission's petition for an injunction against the New England Telephone & Telegraph Company regarding the toll-rate schedule recently established by order of Postmaster-General Burleson. The Attorney-General of Massachusetts, on behalf of the commission, claimed that the resolution of Congress of July 16, 1918, reserved to the states the right to regulate intrastate rates to the same extent as existed prior to federal control of the telephone and telegraph companies. The court holds that as the United States is in possession, as it is not a party to the suit, cannot be interfered with behind its back, and cannot be made a party, the suit must fail.

MEETING OF THE PACIFIC COAST SECTION, N. E. L. A.

Joint Convention at Coronado Will Include Jobbers, Contractors and Dealers Also, and Program Provides for All Interests

The custom established on the Pacific Coast several years ago of having one big joint convention each year will be continued this year, the date having been set for April 30 to May 2, at the Hotel del Coronado, which is on the outskirts of San Diego. This will be the annual meeting of the Pacific Coast Section of the National Electric Light Association, the quarterly meeting of the California Association of Electrical Contractors and Dealers, the quarterly meeting of the Pacific Coast Electrical Supply Jobbers' Association, and a special meeting of the Westinghouse Agent-Jobbers' Association, in connection with which a special train is to be run from Chicago. The latter additional association meeting is expected to add sixty or seventy jobbers from all parts of the country.

All papers are to be printed in advance, the actual meeting being limited to discussion only. The commercial committee has announced a preliminary list of papers as follows: "The Proper Training of the Sales Personnel," by Lee H. Newbert, I. W. Alexander and J. F. Pollard; "The Contractor-Dealers of To-morrow," by John C. Rendler; "The Jobbers' Relation to the Industry," by W. S. Berry; "Means for Establishing Closer Relations Between the Architects and the Electrical Industry," by J. O. Case; "Interesting the Consumer," by T. W. Simpson; "Progress of Electric Cooking and Heating," by B. M. Maddox; "Wiring for Heavy Wattage Appliances," by an author to be announced later.

The engineering committee announces the following list of papers, which is only partly completed: "Protective Relays on Main Transmission Lines," by George

E. Armstrong; "Some Minor Aspects of Interconnected Systems," by L. M. Klauber; "The San Joaquin-Edison Interconnection," by G. R. Kenny; "Development of Small Automatic Power Plants," by E. A. Quinn.

H. H. Jones, manager of the San Diego Consolidated Gas & Electric Company, will act as chairman of the general convention committee, and William Clayton, United Light, Fuel & Power Company, San Diego, will serve as vice-chairman.

AMERICAN WELDING SOCIETY PERMANENTLY ORGANIZED

Prof. Comfort A. Adams Is Elected First President and Prof. Elihu Thomson Is the First Honorary Member

At a meeting on March 28, at which those interested in all kinds of welding were represented, the American Welding Society was officially organized and a constitution and bylaws were formally adopted. The first president of the society is Prof. C. A. Adams, president of the American Institute of Electrical Engineers, and the vice-presidents are J. M. Moorehead, consulting engineer, and G. L. Brunner, Brunner Manufacturing Company.

Directors chosen for a period of one year are: W. M. Beard, Linde Air Products Company; M. H. Roberts, Air Reduction Sales Company; M. M. Smith, Commercial Acetylene Company; L. D. Lovekin, American International Shipbuilding Corporation; Alexander Churchward, Wilson Welders Metals Company; W. H. Patterson, Westinghouse Electric & Manufacturing Company; W. J. Jones, Chester Shipbuilding Corporation, and C. A. McCune, Page Steel & Wire Company. Those elected for two years are: R. R. Browning, Oxweld Actylene Company; Prof. A. S. Kinsey, Stevens Institute of Technology; Victor Mauck, John Wood Manufacturing Company; E. L. Hirt, Bethlehem Shipbuilding Corporation; J. F. Lincoln, Lincoln Electric Company; H. M. Hobart, General Electric Company; D. C. Alexander, Quasi Arc Weldtrode Company, and H. R. Swartley, Jr., Davis-Bournonville Company. For three years there were chosen: L. H. Davis, Linde Air Products Corporation; E. L. Mills, Air Reduction Sales Company; D. B. Rushmore, General Electric Company; James Burke, Burke Electric Company; D. H. Wilson, Jr., Wilson Welders & Metal Company; Hermann Lemp, General Electric Company; C. J. Nyquist, Torchweld Equipment Company, and Alexander Jenkins, Alexander Milburn Company. These directors represent equally those interested in gas and electric welding.

By unanimous vote Prof. Elihu Thomson was elected first honorary member of the society, for his inventions in electric welding. Professor Thomson was characterized by the president as the father of electrical engineering in this country.

An important feature of the bylaws of the society was the plan of organization of an American Bureau of Welding for the purpose of coöperative research and standardization in welding, which will consist of the board of directors and representatives from important societies and associations and also from departments of the government.

The board of directors elected H. C. Forbes, former secretary of the welding committee, Emergency Fleet Corporation, permanent secretary, and W. E. Symons, Galena Signal Oil Company, treasurer.

ORGANIZATION NEEDED TO REPRESENT ALL ENGINEERS

Local and National Engineering Societies to Consider How Best to Develop Concerted Action of Members on Public Questions

How can engineers find out what are the views of the profession as a whole on public questions, and if this is accomplished what can be done to give the judgment of the profession commensurate political weight? The solution of these problems formed the nucleus of the discussion on the papers read last week at the representative meeting of New York engineers.

It was generally agreed that engineers should make themselves a potent factor in public affairs. The consensus of opinion was that this would require an organization embracing all branches of engineering, through which the profession could act as a body locally and nationally. Many thought that some existing engineering organization could be modified or expanded to meet their requirements, and the American Association of Engineers was suggested by Daniel Turner as being suitable for the purpose. Jesse M. Smith pointed out that the United Engineering Society now represents the national societies of electrical, mining, mechanical and civil engineers, that it has permanent quarters and its charter permits it to embrace and represent all the engineering societies of the country. Local divisions of the United Engineering Society could be formed if desired, and Mr. Smith thought it would be ill advised to form another association when an organization of the prestige and experience of the United Engineering Society is available.

In order to crystallize the ideas of all into a form productive of action, C. F. Scott presented the following resolution, referring particularly to New York engineers, which was adopted by the meeting:

Whereas all engineers, as citizens, should invite the fullest coöperation; and

Whereas complete coördination of the engineering profession as a whole is essential for the best interests of the community; and

Whereas it is the sense of this meeting that some program be formulated whereby closer coöperation between engineers may be obtained, therefore

Be it resolved, that the secretary of this meeting be and is hereby directed to so notify the secretaries of the several societies or local sections of the societies here represented to-night, with the request that the several secretaries transmit this resolution to their respective local membership together with an invitation to said local membership to appoint a delegate to attend a joint conference, with a view to organizing so as to obtain closer coöperation between engineers, particularly between the engineers resident in the metropolitan district, whereby they may become more potent in fulfilling their responsibilities as citizens.

The question then came up of asking every engineering society in this country to take some action, and with this end in view Louis C. Marburg proposed the following resolution, which was also adopted:

Resolved, that all engineering societies in this country not yet having committees on development be asked to appoint such committees, with instructions to undertake a survey of the aims and purposes of their respective associations and to coöperate with corresponding committees of other engineering and similar societies, and

It is further resolved that a copy of these resolutions be sent to every engineering society in this country.

A third resolution was placed before the meeting by Nelson P. Lewis and adopted. It was to the effect that the various engineering societies be invited to

appoint representatives who would come together and develop a simple code of ethics which might become the standard for all societies and to which all engineers could subscribe.

In the discussion on the reasons for the apathy displayed by engineers toward activities outside their field, a number of speakers laid much of the blame on the engineering courses of the universities. Prof. Comfort A. Adams said in this regard that much more depended on the instructor than on the subject taught. He said that finer ideals of good American citizenship can be injected into a course on dynamo design than are often given in classes on sociology and allied subjects.

S. N. Castle of the General Electric Company, New York, who acted as secretary of the meeting, assumed the responsibility of notifying the different societies in accordance with the resolutions passed by the meeting.

WISCONSIN ASSOCIATION DISCUSSES LIVE TOPICS

Testing Transformers, Relations with Commissions, Service Extensions and High-Tension Equipment Are Debated

The two important public policy questions discussed at the meeting of the Wisconsin Electrical Association at Milwaukee on March 27 were the relations of the utilities and the Public Utilities Commission and policies on service extensions. J. B. Sanborne of Milwaukee reported on the activities of the State Legislature as applied to public utilities. He said that a bill to make the Railroad Commission elective rather than appointive has been twice defeated. A bill introduced to abolish the commission and the public utility laws should be watched carefully, he said, for if this carries it would leave absolutely nothing to replace the commission form of regulation. A bill has passed the Wisconsin House and Senate to make the fiscal year of all utilities coincident with the calendar year and to accomplish this to permit a report covering a period of six months for those utilities whose fiscal year now ends in June.

The discussion of service extensions was introduced by a paper by A. J. Goedjen, statistician of the Wisconsin Public Service Company, Milwaukee, entitled "A Review of Policies of Service Extensions as Laid Down by State Commissions." This reviewed the activities of many commissions and concluded with the statement that the author believed the Indiana commission's rules on this point were perhaps the best in this country.

"The Proper Loading of Distributing Transformers" was the topic of a paper by Frank A. Robbins, electrical engineer of the Superior (Wis.) Water, Light & Power Company. He recommended the use of self-registering thermometers to measure the maximum safe temperature of transformers. He also suggested that this work should be done in the summer rather than in the fall, which is the usual period for testing transformers.

Alfred Alsaker, chief engineer of the Delta-Star Electric Company, Chicago, delivered an address on "High-Tension Outdoor Substations and Switching Equipment." His talk was illustrated by many lantern slides showing typical installations.

Interesting business activities at the convention included the appointment of a committee to meet with the contractor-dealers and to assist that group in the industry in organizing an effective association. The convention also decided that in the future there shall be a railway division of the Wisconsin Electrical Association.

The officers elected for the ensuing year are: President, Raymond H. Smith, vice-president and general manager of the Eastern Wisconsin Electric Company, Sheboygan; first vice-president, W. C. Lounsbury, general superintendent of the Superior Water, Light & Power Company; second vice-president, A. K. Ellis, superintendent of the Wisconsin Traction, Light, Heat & Power Company, Appleton; third vice-president, L. R. Boisen, vice-president of the Ashland Light, Power & Street Railway Company; secretary and treasurer, J. P. Pulliam, vice-president and general manager of the Wisconsin Railway, Light & Power Company, Winona, Minn.

NEW ENGLAND POWER COMPANY SYSTEM STEADILY EXPANDING

Arrangements Made for Increasing the Generating Capacity of the System by Adding Equipment and by Elaborate Interconnections

The largest gross earnings in the company's history are reported by the New England Power Company system for 1918. During the year the system revenue was $3,557,281, compared with $2,645,973 in 1917, and net earnings were $1,322,880 against $1,144,195 in 1917. The total energy output was 323,000,000 kw.-hr., compared with the previous year's record of 300,000,000 kw.-hr.

The company is now adding at its Uxbridge station a 10,000-kw. steam-turbine unit which it is hoped to have in operation early this month. This will raise the capacity of the Uxbridge station to 15,000 kw. The company has also rewound three 60-cycle generators at its No. 5 station on the Deerfield River, adding transformer and switching capacity to bring the 60-cycle capacity of this plant up from 10,500 kw. to 15,000 kw. The waterwheels were originally designed to handle this increased service, and the station will now be of increased value at times of large stream flow. During the year a synchronous condenser has been installed at the Greendale substation, in Worcester, and the lines of the system have been extended about 18 miles from Ayer to Nashua, N. H. Energy is now being supplied to the Nashua Manufacturing Company, which has contracted for about 6000 kw., instead of enlarging the local steam plant of this concern. It is expected that energy will be interchanged over this line in the future between the New England company and the Manchester Traction, Light & Power Company, thus interconnecting the hydroelectric plants on the Deerfield and Connecticut Rivers with the stations on the upper Merrimac River.

A high-tension connection is being made with the Edison Electric Illuminating Company of Boston, which will enable from 10,000 kw. to 15,000 kw. to be interchanged. Another line has been built from the Millbury operating headquarters of the power company to a new steam-turbine plant of the Shore Line Electric Railway near New London, Conn. This extension will permit an exchange of 10,000 kw. An arrangement has also been made with the Narragansett Electric Lighting Company of Providence, R. I., by which the boiler capacity of that company has been increased, adding 10,000 kw. to the amount of energy which it can deliver to the New England company.

Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 719 of this number.

Rochester Engineering Society.—H. A. Winne, General Electric Company, addressed the March 28 meeting on "Electric Furnaces."

Electric Club of Chicago.—M. Luckiesh, of the National Lamp Works research laboratory, was the speaker at the March 20 meeting and Capt. Florence Spofford, Red Cross Motor Corps, at the March 27 meeting.

A. I. and S. E. E., Cleveland District Section.—W. W. Walsh of the Standard Underground Cable Company, Pittsburgh, Pa., spoke on "Electrolysis" at the March 17 meeting of this section, Association of Iron and Steel Electrical Engineers.

Utah Society of Engineers.—At the monthly meeting held on March 19 papers were presented by E. H. Beckstrand on "Recent Improvements in Steam Prime Movers" and by L. M. Pharis, hydraulic engineer, Utah Power & Light Company, on "Waterwheel Development."

Engineers' Club of Philadelphia.—Arthur J. Baldwin, vice-president of the McGraw-Hill Company, who lately returned from France, is to present an illustrated paper entitled "The Devasted Area and Its Reconstruction" at a special meeting of the Engineers' Club of Philadelphia on April 23.

I. E. S., New York Section.—The tendency of different illuminants to cause loss of visual efficiency or the power to sustain a clear vision of the reading page was clearly set forth in a paper presented by C. E. Ferée and G. Rand before this section on March 20. The paper was entitled "Some Experiments on the Eye with Different Illuminants." Loss of efficiency expressed in percentage change of ratio of total time clear to total time blurring during three-hour tests showed a variation from 5.43 to 54.86 per cent. The lower figure was obtained where the illuminant was unsaturated yellow, whereas the greatest loss of efficiency was obtained from an illuminant in which the dominant color was bluish green with greater saturation. A comparison of the tendency of the different illuminants used to cause loss of visual efficiency and to produce ocular discomfort showed that the smaller the per cent loss of efficiency the greater was the time threshold of discomfort in seconds. This clearly showed the advantage of the yellow illuminant on the reading page to reduce discomfort to the eye. "Transmission of Colored Light Through Fog," by C. L. Utterback, also presented at this meeting, showed that a searchlamp will have a maximum transmission through fogs if the light is composed of wave lengths of from 5300 m. to 5900 m. only.

Springfield (Ill.) Engineers' Club.—J. L. Stair, chief engineer National X-Ray Reflector Company, Chicago, gave an illustrated talk on the art of lighting at the monthly meeting of the club held Friday, March 14. Special emphasis was placed on the illumination of interiors without the use of ceiling fixtures.

N.E.L.A., Philadelphia Electric Company Section.—H. B. Harmer addressed the commercial branch meeting of this section of the National Electric Light Association held on March 25, his subject being "Safety First and Always," while Joseph A. Steinmetz gave a talk before the main section meeting of April 1 on "A Close View of Peace."

New York Electrical League.—Arthur E. Reinke, European engineer for the Western Electric Company, was the principal speaker at the luncheon of the league held on March 27. His subject was "Bolshevism." M. H. Roughton, Australian commissioner on investigation of exports and imports, spoke on existing business relations between Australia and America.

Joint Electrical Meeting at San Francisco.—The California Electrical Cooperative Campaign on March 13 held a dinner-meeting in San Francisco at which there were represented the Pacific Coast Section, N. E. L. A.; the California Association of Electrical Contractors and Dealers and the Pacific Section, Electrical Supply Jobbers' Association, as well as electrical manufacturers. Glen Arbogast, Newbery Electric Company, Los Angeles, reviewed the progress of the coöperative campaign; C. W. Banta, Wells-Fargo Nevada Bank, San Francisco, spoke on "Some Banking Aspects of the Coöperative Movement," pointing out how credit was improved by proper methods of accounting and business analysis, and J. A. Sparlin, manager commercial research department of the Curtis Publishing Company, spoke on "The United States Itself as the Best Market for the Electrical Trade," dwelling on the buying power of the farm.

American Institute of Electrical Engineers

Fort Wayne Section.—Major Darnell lectured on "The X-Ray and Its Application to War Uses" at the March 7 meeting.

San Francisco Section.—W. F. Dietrich spoke on "Mountain Railroad Electrification in California" at the March 28 meeting of this section.

Pittsfield Section.—An illustrated lecture was given by E. F. W. Alexanderson, consulting engineer, General Electric Company, on "Transoceanic Radio Communication" at the March 27 meeting.

Lynn Section.—The eighth annual banquet of the section is to be held in the Boston City Club on April 12, the address of the evening being delivered by Marshall P. Thompson of Boston.

Milwaukee Section.—The Feb. 19 meeting was held jointly with the Engineers' Club, William Bruce, secretary of the Association of Commerce, speaking on "The Activity of the Engineer in Civic Affairs."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Investigation of Surcharges.—The Great Western Power Company and the Pacific Gas & Electric Company have been ordered to appear before the Railroad Commission of the State of California and show cause why the surcharge on light and power allowed by the commission in June of last year should not be reduced or removed. Unless the utilities are able to show that there is a continuance of the abnormal conditions which led to the creation of the surcharge by the commission solely as a means of enabling the light and power companies to function efficiently during war times, the commission will order a readjustment of charges in the direction of the rates that formerly prevailed.

Rate Increase in Illinois.—The Wright Brothers Electric Light & Power Company has been granted by the Illinois Public Utilities Commission a temporary order making effective for a period of six months from March 1 increased rates for electric service. This is an increase of practically 3 cents in the lighting schedule for the first step and 2 cents for the first step of the power service. The top step of the lighting rate is 15 cents, and the top step of the power rate is 8 cents. A temporary order was also issued authorizing an increase in rates for the Dahlgren Electric Light Company for a period of ten months. The rates fixed by the commission are in excess of the franchise ordinance. However, this ordinance provides that nothing in it shall prevent the utilities commission from increasing rates above the maximum provided, which is 15 cents for the first step in residence lighting. The first step authorized by the commission is 17 cents. An interesting part of this decision is that the customers and Dahlgren will be required to purchase meters from the electric utility at the actual price of such meters, provided that the Dahlgren company shall repurchase these meters, in the event of discontinuance of service, at the full price less 7 per cent per year depreciation.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Fund for Research Work.—The National Research Council has been intrusted by the Rockefeller Foundation with the expenditure within a period of five years of an appropriation of $500,000 for promoting research in physics and chemistry, primarily in educational institutions in the United States.

Higher Telegraph Rates.—An increase of 20 per cent of all domestic telegraph rates became effective April 1 under an order issued by Postmaster-General Burleson. The increase was ordered, Mr. Burleson explained, to meet the increased cost of operation occasioned by wage increases now in effect and made during the last year.

Electric Vehicle Stations.—Electric vehicle routes from New York to Philadelphia, Atlantic City, Easton, Pa., Ellenville, N. Y., Pittsfield, Mass., and New Haven are described in the 1919 "Automobile Handbook," just issued by the New York Electric Vehicle Association. A list of charging stations in and near New York with particulars as to capacity and rates is included.

Report of Cities Service Company.—The annual report of the Cities Service Company for 1918 shows earnings growing from public utility operations during the year of $4,229,563, and from oil operations of $18,050,504, making a total of $22,280,067. This compares with $4,742,652 and $14,509,984 respectively in 1917. The reduction of public utility earnings is accounted for by the high costs of money during war times to finance growth and refund maturing bonds.

Central Station Exhibit in Chamber of Commerce Rooms.—A comprehensive exhibit of local manufactured products is maintained by the Hartford (Conn.) Chamber of Commerce, and among the various displays the Hartford Electric Light Company has provided twenty-five 8-in. by 10-in. photographs of its representative installations. These are mounted on revolving panels and include fifteen views of typical power installations, five views of different types of commercial lighting layouts, and five views of electric heating equipments used in industrial plants and showing japanning and varnishing ovens used in the manufacture of world-famous products. One panel in the company's exhibit is devoted to statistical data showing in graphic form the growth of the company's connected power load over a series of years, the purchasing power of a dollar in electrical energy for lighting service, and comparisons of the average price of energy in various cities against the Hartford rate.

Drought Adds to Cost of Power.—Lack of rainfall and snowfall in the mountains on the Pacific Coast last year cost the hydroelectric companies of California more than $3,000,000, according to the report of the State Railroad Commission. Owing to this condition the hydroelectric companies were compelled to use 2,000,000 barrels more of oil for the production of electricity than would ordinarily be necessary. This oil was formerly sold at from 65 to 80 cents a barrel and jumped to a minimum of $1.50 a barrel.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Right to Place Poles in Streets a License, Not a Franchise.—An answer in an action to compel an electric company to remove its poles, etc., from streets, that city was estopped from prohibiting defendant to occupy the streets, did not raise a question of freehold, the answer not stating how long the city would be estopped, the Supreme Court of Illinois held in City of Sullivan versus Central Illinois Public Service Company (122 N. E. 58). Where a municipal corporation grants a utility the right to use streets without a time limit as to duration of right, such grant is not perpetual and is necessarily limited to the life of the corporation granting it or the corporation obtaining such right. The power conferred by a city on a company to locate poles, etc., in its streets is a license and not a franchise, and hence actions involving right to use of streets by such a company does not involve a franchise so as to give right of direct appeal.

Election Under Workmen's Compensation Act.—In suit based on the first clause of the workmen's compensation act, Section 29, to recover amount paid for lineman's death, due to his coming in contact with defendant's high-tension wires, a declaration which in substance alleged that defendant was engaged in "electrical work" was not defective because it failed to allege that defendant had not elected to be governed by the act, in view of Section 2, according to the Supreme Court of Illinois in Vose vs. Central Illinois Public Service Company (122 N. E. 134). In suit by employers under the workmen's compensation act to recover amount paid for an employee's death, due to contact with defendant's high-tension wires, where defendant was engaged in an occupation making it subject to the act, unless it elected to the contrary, and the proof showed that neither plaintiffs nor their employee had made any election, judgment will not be reversed because plaintiffs did not prove that they and their employee had elected to be bound by the act.

Public Service Commission Fees.—Despite the fees and salaries act and the cost act, under the public utilities act, Section 7, the Public Utilities Commission is not entitled to fees for making a transcript of proceedings before it for use on appeal from its order to the circuit court and is not excused from performing duty enjoined upon it until such fees are paid, the Supreme Court of Illinois held in Kennedy versus State Public Utilities Commission (122 N. E. 111).

Workmen's Compensation.—Where defendant did not plead that either deceased or his employer was subject to the workmen's compensation law, the court did not err in refusing to allow defendant to introduce testimony in support of defense that plaintiff, deceased's wife, had filed her claim for compensation with the Industrial Commission, according to the Supreme Court of Colorado in Arkansas Valley Railway, Light & Power Company versus Ballinger (178 P. 566). Writing the Industrial Commission a letter stating the fact of the accident and that plaintiff would apply for compensation did not constitute an election under the workmen's compensation law. Defendant light company, which directed decedent's employer to remove electric transformers at defendant's distributing point, was under the duty to exercise the highest degree of care and use the utmost degree of caution and foresight to avoid decedent's coming in contact with live wire which was defectively insulated.

Burden of Proof in Negligence Over Sagging Wires.—When plaintiff has proved that he sustained injuries through the dangerous situation of a telephone wire hanging across a public highway, the burden passes to the defendant to show that the dangerous situation of the wire was not due to the act of the defendant and had not existed for such length of time as to charge the defendant with notice of its defective condition, the Supreme Court of Oklahoma held (178 P. 666). In the trial of an action for personal injuries alleged to have been received by a person while driving on the public highway in a covered wagon, where the telephone wires across said highway became sagged and caught the covering of the plaintiff's wagon, throwing him to the ground and injuring him, it is an error for the court to refuse to instruct the jury that "persons traveling upon a public highway have a right to assume that persons using said highway, by maintaining and stringing telephone wires across the highway, have performed their duties, and that the highway is in a reasonably safe condition for public travel," the Supreme Court decides.

William Lennon has been appointed successor to H. P. Blodgett as superintendent at Gardiner for the Central Maine Power Company.

A. L. Strickland, for the past year district manager for the Pacific Power & Light Company at Seaside, Ore., has been transferred to Pasco, Wash.

Prof. M. I. Pupin of Columbia University is on his way to France to the Peace Conference. Prof. Pupin was Royal Consul General for Serbia to the United States until recently.

Charles J. Marsh, vice-president of the Standard Underground Cable Company and one of the foremost authorities in the United States on the copper market, has been elected president of the New York Metal Exchange.

Prof. Comfort A. Adams, who was elected president of the American Welding Society at its first meeting on March 28, also, it is announced, has been chosen dean of the faculty of the Harvard School of Engineering at Cambridge, Mass. Professor Adams is at the present time president of the American Institute of Electrical Engineers.

W. M. Wood, heretofore assistant to the general manager of the Pacific Power & Light Company, Portland, Ore., has been appointed assistant general manager with headquarters at Portland. Prior to going to Portland in the fall of 1917 Mr. Wood was district manager for the company at Lewiston, Idaho, and before that was in charge of the company's Sunnyside office.

L. C. Stang has succeeded Frank Glosser as superintendent of the light and power department of the Columbus, Delaware & Marion (Ohio) Electric Company. Mr. Stang has been an electrical engineer in the chemical warfare division of the army. Prior to going into the service he was an electrical engineer with Sargent & Lundy, consulting engineers, Chicago.

Sir Oliver Lodge, who has been principal of the Birmingham (England) University since its establishment nineteen years ago, will retire from the position at the end of the present session to devote himself to his studies of the physical and psychical relations of the ether of space. Sir Oliver has been well known throughout the world for his researches in electrical science, particularly with relation to radio work.

Col. Peter Junkersfeld, who had recently returned to his civilian work as assistant to the vice-president of the Commonwealth Edison Company, Chicago, as stated in the ELECTRICAL WORLD on March 15, resigned on March 31 to become engineering manager for Stone & Webster. Colonel Junkersfeld was in charge of the construction of all cantonments while in the army and also in charge of the construction of some of the large gas-plant undertakings of the government, in charge of two or three of the large new docks and of other new work aggregating in excess of $600,000,000.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Raymond H. Smith, vice-president and general manager of the Eastern Wisconsin Electric Company, with headquarters at Sheboygan, Wis., has been elected president of the Wisconsin Electrical Association and the Wisconsin Gas Association. Mr. Smith entered the utility field with the Waterbury (Conn.) Traction Company in 1897 and held various positions in the electric and railway department until 1900, at which time be became assistant superintendent of railways. In 1900 he was transferred to the headquarters of the Connecticut Railway & Lighting Company at Bridgeport as purchasing agent and secretary to the general manager. In 1903 he was made superintendent of the company at Bridgeport and held this position until 1907, at which time he became general manager of the Albany (N. Y.) and Hudson Railroad Company. This company two years later passed through a receivership. Mr. Smith was made receiver and later became general manager of the reorganized company. In 1912 he became general manager of the Jackson (Miss.) Light & Traction Company, which position he held until 1916. In November of that year he was made vice-president and general manager of the Sheboygan (Wis.) Electric Company. When in March, 1918, this company was consolidated with the Wisconsin Electric Railway Company of Oshkosh and the Eastern Wisconsin Railway & Light Company of Fond du Lac, Mr. Smith was made vice-president and general manager of the consolidated company, named above.

RAYMOND H. SMITH

Obituary

F. M. Grant, president of the F. M. Grant Electric Company, electrical contractors and engineers, died recently at his home in Cleveland, Ohio, at the age of fifty years, after a short illness. He formerly was associated with the Erner Electric Company of Columbus and entered business in Cleveland five years ago with W. C. Harrington.

Emil C. Braun, electrical engineer, who came to the United States in charge of the German electrical exhibit at the Chicago World's Fair in 1893, died suddenly in Chicago on March 22 at the age of fifty-one years. Mr. Braun had been connected with H. M. Byllesby & Company since the organization of the company in 1902. He was a graduate electrical engineer of the University of Berlin.

Capt. Stuart Thomson, consulting engineer for the General Electric Company and son of Dr. Elihu Thomson, died from pneumonia on March 23. Captain Thomson was a graduate of Harvard University and of the Massachusetts Institute of Technology. He had but recently returned to Schenectady from Washington, where he had been for a year and a half in charge of engineering and production of aircraft armament, Ordnance Department.

Major James Alfred Roosevelt, member of the consulting engineer firm of Roosevelt & Thompson, New York City, and cousin of the late Theodore Roosevelt, died last week on the naval transport Great Northern while the steamship was 400 miles east of Sandy Hook. Major Roosevelt was well known for his ability to manage utilities, particularly electric railway companies. In 1911 he directed the operation of the British Columbia Company, which operates electric light and railway systems in British Columbia. He went overseas with the Seventy-seventh Division and was cited at Vesle River for displaying exceptional bravery and courage under heavy fire.

M. L. McKinley, one of the pioneers in the installation and construction of electrical distribution systems on the Pacific Coast, died on Feb. 19. He entered the employ of the old Thomson-Houston Company in 1889 and after some experience in the construction of the St. Louis street railway system and street-lighting system and later at the Chicago World's Fair he went to the Pacific Coast in 1894. There he formed a partnership with Messrs. Dunn and Peterson to engage in electrical contracting. They installed the first underground system in San Francisco for the Pacific Power Company in addition to a number of other important lines. Mr. McKinley was general manager for the Tuolumne County Electric Light & Power Company for ten years until its purchase by the Sierra & San Francisco Power Company. Since that time he had been continuously asociated with Capt. H. F. Jackson, president and general manager of that property, in its management and operation.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

FUNDAMENTAL SNAP-SHELL SOCKET PATENTS UPHELD

Judge Hough Sustains the Decision of Court Holding that Cutler-Hammer Sockets Infringe Meter Patents

Weber patents for snap-shell sockets have again been upheld as fundamental. Judge Hough on Jan. 22 filed in the United States Circuit Court of Appeals for the Second District his decision in Weber Electric Company versus Cutler-Hammer Manufacturing Company, affirming the decision of Judge Hand sustaining the Weber snap-shell patents against Cutler-Hammer sockets.

After reviewing previous decisions upholding their patents, the court pointed out "that by Jan. 1, 1898, Weber had embodied the invention described and claimed in his earlier patents, which invention is a positive lock for the engagement of the sleeve and cap of lamp sockets, as distinguished from any and every variety of friction device."

The court held that the patent was valid over the Kenney patent, which made use of a frictional lock.

The case therefore came down to a question of the varying degree of strength necessary to engage the sleeve and cap of the sockets. "If they engage by a straight thrust," the court held, "infringement is too clear for discussion; if they fit only under force, it is but a question of degree. Whether thumb pressure suffices or hand power is increased by the use of Klem's lever, it is hand power just the same. The vital point is that Weber's way is to engage by a straight thrust and release by pressure on the sleeve at a point under an engaging projection. Defendant always effects both processes in substantially the same way, because under the range of equivalents always hitherto accorded these patents it makes no difference that sometimes defendant's cap has to be locked on and disengaged with more power than resides in most thumbs."

JANUARY RECORD MONTH FOR ELECTRICAL EXPORTS

Large Shipments of Insulated Wire, Tungsten Lamps and Meters Help Bring Total for Month Up to $6,772,524

Electrical exports opened the current year with another new monthly record. Figures for January show that electrical merchandise to the value of $6,722,524 was exported, or more than $500,000 in excess of the previous record month, which was last November.

Particular interest attaches to the very large shipments last January of insulated wire and cable, metal-filament lamps, and meters and measuring devices. The wire exports for the month were more than $800,000. About a third went to South America, Brazil alone taking $109,722. British South Africa took $101,234, or slightly less than the amount of wire shipped into the whole of Europe. It is also interesting to note that Mexico absorbed $44,493 of the wire, and Cuba $69,053.

Metal-filament lamp exports for January amounted to $578,175, the value of 2,657,117 lamps. In this case Bolivia was the largest customer, taking 674,421 lamps, valued at $134,551. Mexico and British South Africa were also large customers.

In the meter market, which amounted to $324,404, Australia led at $105,924. Japan purchased meters to the value of $48,153.

The exports of fans, heating and cooking apparatus, interior wiring supplies and motors also showed very satisfactory totals for the month of January.

For the seven months ended January last the exports amounted to $38,829,292. At this rate the total for the fiscal year ended June 30 next should be not far short of $70,000,000.

The figures in the accompanying table were compiled by the Bureau of Foreign and Domestic Commerce:

Articles	January 1918	January 1919	Seven Months Ended January 1918	Seven Months Ended January 1919
Batteries	$295,520	$345,811	$2,072,340	$1,949,230
Carbons	93,543	189,351	833,260	1,004,860
Dynamos or generators	252,429	249,853	1,286,941	1,959,545
Fans	68,541	176,526	340,731	477,705
Heating and cooking apparatus	59,652	98,515	316,185	507,399
Insulated wire and cable	548,931	804,481	3,768,016	3,897,729
Interior wiring supplies, including fixtures	104,710	194,565	877,386	863,547
Arc lamps	671	206	7,315	7,681
Carbon filament lamps	9,567	20,041	104,486	73,071
Metal filament lamps	200,420	578,175	1,654,007	2,218,438
Magnetos, spark plugs, etc	380,098	279,174	2,137,946	1,619,402
Meters and measuring instruments	124,192	324,404	779,780	1,275,722
Motors	555,842	680,882	3,771,313	5,522,886
Rheostats and controllers	13,007	48,436	106,619	218,746
Switches and accessories	271,196	177,159	1,296,199	1,168,439
Telegraph apparatus, including wireless	9,208	56,541	174,102	305,944
Telephone	249,992	214,172	1,373,230	1,457,964
Transformers	174,001	309,028	1,179,228	2,498,960
All other	1,245,091	1,975,204	9,247,723	11,802,024
Total	$4,656,611	$6,722,524	$31,326,807	$38,829,292

COPPER WIRE MAY HAVE REACHED LOW PRICE LEVEL

Judging from the Way Wire Has Followed Copper Down, It Would Not Be Surprising to See Higher Prices Soon

There seem good reasons to believe that copper wire and cable have reached their low level in price, at least for the time being. Wire producers have closely followed the downward price of copper with lower wire prices. While copper was dropping from 26 to 14½ cents (the lowest price reached), rubber-covered wire, for instance, dropped from a 34-cent base to a 20-cent base. Some of this reduction in wire base came prior to the first of January when the government copper price of 26 cents was no longer in effect.

Since March 3, when the low price of 14½ cents was reached, copper has been slowly advancing until at this writing it is 15½ cents. Larger and better sales have been made since the price began to advance, and in spite of the fact that there is more than a year's production of copper in stock and unsold, it would not be surprising to see copper go over 16 cents or even a bit higher. Of course, the producers are feeling out the market and will not increase the price beyond a point at which buying begins to fall off.

Since copper went to its low level, four weeks ago, wire producers have not raised their prices. What looked to be a tendency toward a turn last week proved to be a false alarm.

Nevertheless, if wire continues to follow copper as closely as it did during January and February, higher base prices can be expected shortly.

To those who are planning to lay in stocks of wire or to build transmission lines or distribution systems it seems reasonable to believe that current prices are the lowest they will be this year.

METAL MARKET SITUATION

Copper Sales Show an Increase—Central European Powers Are Short of Copper Supplies

A decided improvement was noticed in the copper market this past week. The price of electrolytic metal increased ¼ cent to 15¼ cents per pound, and it is the opinion of many that the bottom copper price has been reached and the upward market has commenced. Sales of refined metal for the week have been estimated at approximately 50,000,000 lb. and for the month of March at 75,000,000 lb., or 20 per cent greater than February sales and five times the January business.

Trading in electrolytic copper in 25-ton blocks and larger was resumed on the New York Metal Exchange on March 31, after a lapse of nearly four years.

The foreign demand for copper has not been satisfied, despite the stocks held by the European governments. Most of the recent inquiries have come from England, where the need is for wire bars and other forms not readily available abroad. Foreign stocks are for the most part ingot bars. Exports for the month have been approximately 9000 tons.

C. F. Kelley, president of the Anaconda Copper Mining Company and chairman of the Copper Export Association, whose committee has just returned from Europe, states, according to a report, that "stocks of copper, while apparently large, are concentrated in the hands of the respective Allied governments. The copper-consuming industries in those Allied countries are without stocks of metals. Government stocks are being used and will be very much reduced in the near future by distribution among the consumers who are now doing a fair business. Germany and what was Austria have completely exhausted their stocks and undoubtedly will be in the market for large quantities of copper as soon as trade restrictions are removed."

There has been a slight increase in the price of spelter, but the market is very quiet. A meeting is to be held in regard to the disposition of government stocks of spelter.

The scrap-metal market is still practically inactive but is encouraged by the advance in copper prices. Scrap copper and zinc have increased fractions of a cent.

NEW YORK METAL MARKET PRICES

	March 25	April 5
Copper:	£ s d	£ s d
London, standard spot	78 0 0	78 0 0
	Cents per Pound	Cents per Pound
Prime Lake	15.25 to 15.50	15.75
Electrolytic	16.25	15.50
Casting	14.87½	15.25
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.25	5.25
Antimony	6.62½	6.50 to 6.62½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.52½	6.55 to 6.60
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	29.00	29.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	12.75 to 13.00	13.00 to 13.25
Brass, heavy	7.25 to 7.50	7.25 to 7.50
Brass, light	6.00 to 6.25	6.00 to 6.50
Lead, heavy	4.25 to 4.50	4.25 to 4.50
Zinc, old scrap	4.00 to 4.50	4.25 to 4.75

THE WEEK
IN TRADE

BUSINESS appears to be on the threshold of better times. Building is increasing, prices are lower in many fundamental commodities, and the market appears to be more stable than it has been for some time.

Iron and steel commodities are lower, following the reductions in the basic materials. Prices of other goods made largely of iron and copper either have dropped or are about to drop. On other lines there appears to be no tendency toward a break at this time.

Labor appears to be quieter this week than it has been. Farming sections are beginning to call for labor, thus relieving the condition of non-employment to a considerable extent.

The number of inquiries being received is attracting attention everywhere. The trade, however, should not be too quick to take this as an indication of large business about to begin all at once. It is probably true that buyers are doing more shopping to-day than formerly and also are paying more attention to daily conditions.

NEW YORK

Jobbers state that March business did not show any improvement over the volume of business done in February. There is a certain amount of trade constantly going through, and at times there have been little spurts which have given rise to the hope that business was not merely transitory. But the month as a whole averaged only fair. There is still little material being bought for stock.

Lower metal prices are being transmitted to a number of products. It is too early, however, to notice any appreciable change in buying. There are other factors affecting the volume of buying which have not yet been overcome.

Collections have been reported by jobbers as very good. Some are averaging forty-five days from industrials, while others can't expect to do better than sixty days. Contractors, however, many jobbers find, are taking the limit of any time permitted.

Manufacturers are finding that they are required to devote an unprecedented amount of time to inquiries for prices and deliveries and in many cases can hardly keep up with this work.

OUTLET BOXES.—There has been a 10 per cent decrease in the price of outlet boxes and covers.

MOTORS.—There has been a very good market recently for variable-speed motors for printing-press work.

STEAM SETS.—The market for steam-driven generating sets in the neighborhood of 100-kw. capacity has become quite noticeable. These are particularly for marine work.

LIGHTING FIXTURES.—The good demand for lighting fixtures in the remodeling and reconstructing of industrial and commercial buildings and of homes continues. Deliveries can be made in three weeks.

TRANSFORMERS.—There has been a recent reduction of 10 per cent in distribution-type transformers, in sizes up to 200 kva., 35,000 volts.

FLATIRONS.—One prominent make of 6-lb. flatirons is off 50 cents.

DRY BATTERIES.—A prominent manufacturer states that there is no tendency toward a drop in price. The only item of manufacture which has decreased is that of zinc, and this plays too small a part in the cost of the battery to effect a change in price.

FLEXIBLE METALLIC CONDUCTOR.—Recircuiting and remodeling work is keeping this material moving very consistently.

SMALL MOTORS.—Although no jump in sales has been noted, the market in sizes up to 50 hp. is keeping a constantly upward trend. One prominent manufacturer is placing two motors in stock for each one sold. Manufacturers have not yet had to contend with government motors thrown back on the second-hand market because many second-hand dealers have not bought them up on account of their already large stocks. Many of these motors have never been uncrated.

SCHEDULE MATERIAL.—There is no likelihood of any reduction in price for some time to come. The demand is very light. When ships now in use in the transport service can be released for repairs, there will without doubt be a very large demand for this material.

POLE-LINE HARDWARE.—Reductions of 5 per cent have been reported.

WIRE.—Rubber-covered base still holds on 20 cents, although the average is slightly below that last week, as one manufacturer has changed from 22 cents to 20 cents. There are seven producers quoting on 20 cents, and one each on the bases of 18, 19, 22 and 23 cents.

CHICAGO

The building situation will probably not take definite shape until the price of brick, which is now being investigated, is definitely settled. However, the buildings projected still continue to run into high figures, a number of architects reporting in the brick investigation that about $93,000,000 worth of building was being held up in Chicago by this investigation. The building news this week includes a million-dollar theater, a million-dollar office building, one factory to cost $300,000 and one to cost $250,000, a hospital addition at $300,000, while apartment buildings proposed run about $2,000,000 for the week.

INCLOSED SWITCHES.—John E. Gamber, fire marshal for Illinois, has issued a general order which requires that all knife switches other than those used on switchboards and panelboxes are to be of the approved safety inclosed type, so arranged that they can be operated by a suitable handle on the outside of the box when the door of the box is closed. The order also specifies that the switch must be designed in such a way that it can be locked in the "off" position. Means must also be provided to lock or seal the cover of the case. Each switch shall have a suitable grounding device to permit the grounding of the outer cases when required.

COPPER WIRE.—While the market prior to last week was badly demoralized and while jobbers during that period sold wire at prices considerably below that justified by the market, it seems to be definitely understood now that this period of demoralization has passed. The demand has picked up, and it appears that a very healthy demand will be established in the future. Rubber-covered wire and weatherproof wire are both quoted on a 20-cent base by Chicago jobbers at the present time. The situation at the mills among the wire people is that shipments are being made regularly, but the cord people are pretty badly behind.

CONDUIT.—Jobbers are quoting on Card 42, which is down five points.

WASHING MACHINES.—Manufacturers are very optimistic over the outlook, the possibility being that records for this quarter will show an increase of from 30 per cent to 40 per cent in the business, based on units of production. No reduction in price is anticipated during 1919.

ELECTRIC SIGNS.—The electric sign market is experiencing an actual boom. Thousand-lamp signs are sold daily in the regular routine of business.

BAKE OVENS.—Electric bake ovens and the heavier type of electric heating equipment are having much heavier sales.

ELECTRIC APPLIANCES.—The export business of the electric appliance manufacturers is proving to be a considerable factor in keeping the factories busy to practically the limit of output at the present time.

LINE MATERIALS.—The market for line materials with the opening of the spring construction appears to be getting well under way.

BOSTON

A better feeling dominates the trade this week. Inquiries are coming in well for both large and small work under consideration. Stocks are being maintained by stop-gap orders for the most part. Collections are a little slow and seem likely to remain so until after the Victory loan is floated. The central stations are proceeding cautiously regarding expansion, but are gradually relaxing considerably from their restrictive policies of the past year or two. In some parts of New England business is rapidly picking up, notably in the Connecticut Valley. Prices show little change.

House-wiring material is beginning to move faster, despite the absence of a real spurt in building operations. Architects are busy on plans and estimates, and in some localities the electrical contractors are finding more work to do than for many months. Great activity is noted in the manufacture of electrically driven refrigerating equipment. This appears to be the outcome of the mild winter and a large turnover is expected in this branch of electrical manufacturing this year. Deliveries are still improving.

ELECTRICALLY OPERATED REFRIGERATING EQUIPMENT.—A representative New England concern reports being swamped with domestic orders. Labor and material are both plentiful and prices are holding steadily.

SCHEDULE MATERIAL.—Orders placed with the factories show some improvement, though the volume of business is still below normal. Push-button switches for 110-volt service are in large demand at present. Jobbers are well stocked.

FANS.—Deliveries for this year's trade have been completed in the case of one of the larger jobbing houses. It is expected that the demand will not be seriously affected by price considerations.

STORAGE BATTERIES.—Trade is brisk, with firm prices and steady improvement in deliveries. One popular type of industrial truck battery is now being shipped on a thirty-day basis, compared with sixty to ninety days' quotations a few months ago. Local stocks of ignition batteries are in excellent shape and the market is exceedingly active. Isolated plants are buying batteries to some extent at present for oil-switch operation.

FIXTURES.—Stocks are still rather large, but purchases for the improvement of old houses are a feature of the market. Prices show little change. The demand is quickening a little, compared with a few weeks ago.

MOTORS.—The motor market is a little quieter this week, but prices do not reflect any extended change in conditions. Purchases are being made on a moderate scale, and close observers do not appear to be discouraged with the future outlook. A representative dealer expects business to pick up materially in the early summer and reports that he is now selling motors at a rate closely comparable to pre-war figures. In general the trade is coöperating to prevent excessive depression of prices through the casting of second-hand equipment upon the market at prices far below the intrinsic value of the apparatus. The high cost of labor seems to preclude reductions at present on new motors.

STARTING AND LIGHTING SETS.—A large amount of this equipment is being sold. The fear of the public that new automobiles would be hard to get this year resulted in a record business in the winter just past in fitting old cars with electric starters. Stocks are in good shape.

DRY BATTERIES AND FLASHLIGHTS.—Trade is fairly good. The former shortage in dry cells has been largely overcome, and the price advances of the war period do not seem to have affected business adversely.

APPLIANCES.—Domestic labor-saving equipment is moving well in many parts of New England. Deliveries are very good at present, but jobbers will do well to keep ahead of the demand for washers and cleaners.

INDUSTRIAL HEATERS.—The demand is rapidly increasing for fast heaters of the portable stove type, rated at about 1200 watts, together with electric heating pads and food warmers for factory first-aid and other service. A recent law providing for heating facilities of the above general character is stimulating this class of business.

ATLANTA

Southeastern electrical interests have enjoyed a big business through government account during the past two years, and the announcement of the War Department this week will be of further interest. The General Staff recommends that the following camps be purchased and made permanent: Sevier and Jackson, South Carolina; Bragg, North Carolina; Jesup, Benning, Gordon, Taylor and Souther, Georgia; Johnston, Dorr and Carlstrom, Florida; Sherman and McClellan, Alabama; Park Field, Tennessee. For the past few months the total purchases from these sources have fallen off to a considerable extent owing to unsettled conditions, but it is felt that when the various camps are again put on a more permanent basis a satisfactory volume of orders will be received.

The reductions in the price of some steel and iron products and spotty reduction in other materials presages an increased volume of buying, but a feeling of uncertainty still exists as the consumer expects other cuts. Smaller buildings and homes in the Southeast are scarce and a small boom has started in this type of construction. The lumber industry is quite active.

Electrical retail sales continue active, and the volume of business is above that of the previous year. A few jobbers report a slowing down of orders on account of decreasing prices, the prevailing tendency being to place fill-in orders.

The strike of the Brotherhood of Railway clerks has ended and distribution has reached normal. The Ware County Light & Power Company, Waycross, Ga., has been granted an increase in lighting rates from 12 to 13 cents.

CHARGING SETS.—Equipments of all types are moving fast and transactions show a substantial increase over last month. One manufacturer is ten weeks behind on orders This line has opened up remarkably during the past year, and all jobbers are particularly active in pushing sales.

TRANSFORMERS.—Local stocks are in excellent shape and reports from other distributing points indicate that stocks are rapidly reaching normal. This section was notified of a reduction on March 24 of 10 per cent in 2300-volt ditributing type. The demand for the heavy power sizes is still off, and no change in prices has been recorded since February.

LIGHTNING ARRESTERS. — A comparison of this month's sales with the same period of last year shows a decrease in the value of orders and the general volume of transactions. An analysis of the situation further shows that while the government bought heavily this time last year, present purchases from this quarter are at a low level, and that to-day's trade is maintained by an increasing call from industrials and central stations. Manufacturers are a little disappointed, however, as bigger business was expected from the central stations to cover normal seasonal requirements.

METERS.—The call from central stations is good and a steady influx of orders has maintained this branch of the industry while others have shown a decrease. Stocks are ample for current needs and nearly normal.

BELL-RINGING TRANSFORMERS.—Jobbers and dealers are placing substantial orders, anticipating an increased demand coincident with and following proposed national publicity for this item.

SEATTLE—PORTLAND

Prominent Seattle jobbers and dealers report that considerable new business has developed as the result of the reopening of shipyards and that business is looking up. However, increased sales to shipyards of past weeks have not justified expectations. Shipyards are not buying nearly as heavily as before the strike. Inquiries for motors and electrically operated logging and lumbering equipment still continue to pour in, but orders are developing very slowly. Central-station and rural utility company buying has not developed as was expected at the time of the signing of the armistice. It is now believed locally that central stations will postpone buying for extensions at least several months more and that buying for maintenance purposes only will be the rule.

During the past week a 5 per cent drop in conduit was noted. This is the first decrease of any importance for several weeks. Both jobbers and retailers report that appliances are moving a shade faster, this being particularly true of washing and sewing machines, flatirons and vacuum cleaners. Ranges are moving about the same, although an increase in number of sales is being freely predicted by large retail concerns. Several jobbers' stocks are in excellent condition, and shipments are coming through well.

Alaska business from present indications will be comparatively light this year. Seattle jobbers state that the amount of business transacted will depend largely upon what the government intends to do with its Alaska projects. Buying from mining companies, fisheries and privately owned utilities is expected to be exceedingly light and merely for maintenance. No projects of any magnitude have been announced.

It is believed in Seattle that the prospects of another strike for higher wages are very remote. All shipyards are running full blast with larger crews than before the strike. While the decision of the Shipping Board to bring the wooden ship building program to an end does not affect present conditions in Gray's Harbor or Seattle and Tacoma yards, which will continue work on uncompleted contracts, the future status of the industry is more or less uncertain. Eastern Washington, especially in the Wall, Yakima and Wenatchee districts, is loudly calling for farm help. The situation is acute. It is reported that nearly every county in Oregon is also calling for farm laborers.

The Portland district reports that business during the past week shows no particular increase over several weeks past. Manufacturing interests report an unusual number of exceptionally good prospects for business in the immediate future. Several jobbers report inquiries regarding connection equipment for proposed industrial enterprises. Renewed activity is noted in business building, particularly garages and warehouses. Residence building continues brisk. The Port of Astoria has plans under way for the expenditure of $1,300,000 in permanent buildings, including a third municipal pier. The city purchasing agent of Seattle is calling for bids until April 11 for furnishing 400,000 incandescent lamps for the ensuing year.

SAN FRANCISCO

Outwardly there has been little change in the financial or business situation during the past week. Locally there is every feeling of confidence. California looks for bumper crops with a greatly increased acreage. The bountiful rains of the past season have gladdened the hearts of the farmers, and the certainty that prices will be maintained assures them prosperity for 1919.

There is little new building reported. A number of residences have been started, however, by real estate companies for speculation.

Collections from dealers and contractors are surprisingly good. In the opinion of shrewd credit men this is because the electrical trade is no longer inclined to take work recklessly without regard to credit risk, and this general determination has compelled previous slow-paying customers to fall into line.

HEATING DEVICES.—Surplus stocks of small heating devices carried over from the holiday season have cut dealers' purchases to a negligible demand, but a gradual sale of stock on hand, coupled with the usual spring business, will restore its tone. Many dealers are again soliciting this small heating-device business on a partial payment scheme which is working out nicely.

HOUSEHOLD APPLIANCES.—Although purchases of smaller electrical household helps are curtailed, it is a testimonial to the far-sighted economy of the buying public that sales of such devices as washing machines and vacuum cleaners have doubled. This is primarily caused by the continued shortage of household help and the high prices for it when obtainable. Liberal credit terms are given by the electrical jobbers as an encouragement.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
1	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
½-in. single trip	$75.00	$63.75— 69.75
½-in. double strip	75.00— 82.50	72.00— 75.00
¾-in. single strip	100.00	85.00— 93.00
¾-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
½-in. single strip	$75.00	$63.25 to $63.75
½-in. double strip	78.25 to $78.75	71.25
¾-in. single strip	100.00	75.00 to 85.00
¾-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
¾	.09	1½	.40
¾	.12	1¾	.47
¾	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$25.00	$20.00	$18.00
½-in.—	30.00	24.00	21.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$60.00	$30.00	$26.00–26.50
½-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 12.1%	9% to 14.1%
2500 to 5000 lb.	10% to 15.1%	12% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS
NEW YORK

List price	$7.00 to $7.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.18
Coil to 1000 ft	25.94

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	5%
1/5 to std. pkg	15%
Std. pkg	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $17.00
1/5 to std. pkg	12.00 to 14.00
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$21.00–$24.15
1/5 to std. pkg	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg	$16.00	$22.00
1/5 to std. pkg	13.60	18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to list
1/5 to std. pkg	+5% to 10%
Std. pkg	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%	List
$2.00 to $10.00 list	28%	5%
$10.00 to $50.00 list	45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.38
No. 18, full spools	.36

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33.12	27.60	22.08
6	52.50	43.75	35.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00–$20.00	$13.00–$15.00	$11.50–$13.00
12	17.50– 21.63	17.55– 21.63	17.55– 18.54
10	24.05– 28.91	24.05– 28.91	21.16– 24.78
8	33.35– 39.34	33.35– 33.72	29.35– 33.72
6	52.95– 61.74	46.60– 52.92	46.60– 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$25.25
25 to 50 lb	25.25
50 to 100 lb	24.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $35.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb	23.75 to 37.35

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Knife-Blade Renewable Fuse with Jacketed Link

An important feature of the knife-blade renewable fuses recently developed by the D & W Fuse Company of Providence, R. I., is the "expulsion" or jacketed fuse link, which consists of a flat strip of metal having a slot in the central portion and closely

JACKET SUPPRESSES ARC

wrapped with a covering of specially treated asbestos. The jacket is said to be unaffected by high temperatures and remains intact even when the fuse blows from a short circuit. When the link fuses, the metal within the jacket is converted into a vapor, thereby developing internal pressure within the jacket. This causes a blast of hot gases in each direction from the center of the fuse, tending to extinguish the arc. When the metal has burned back to the terminals the jacket drops out, thus breaking up mechanically any strata of vaporized gas which might tend to maintain an arc between terminals.

With this jacketed link a longer life is obtained for the casting, says the manufacturer. Another advantage of the link is the increased radiation surface effected through using the jacket, which makes possible a considerable reduction in the total mass of metal required for a given current. By this means a considerable lowering of the pressures developed when the fuse blows on a dead short circuit is effected.

The inner caps on the ends of the heavy fiber tubing are slotted to receive the fuse link and to engage the blades, which are locked by giving them a quarter turn. Asbestos-lined metal washers slip over the blades to align them properly and to regulate the escape of gases. The outer caps screw over the inner ones holding the washers in place. The large quantity of metal used in these fuses helps to cool the gases, which pass along, engaging the screw threads of the ends of the shell and the outer metal caps.

These renewable fuses, according to the maker, will meet the short-circuit tests imposed by the Underwriters' Laboratories, Inc., in which one fuse at a time is subjected to full rated voltage at 10,000 amp.

Industrial Truck with Underslung Battery

The type U-2 industrial truck with a load capacity of 2 tons being placed on the market by the Industrial Truck Company of Holyoke, Mass., has an underslung battery, transmission by lubricated inclosed universal joints and a single-reduction worm drive. The dimensions of the carrying platform are 90 in. by 46 in. (2.2 m. by 1.1 m.) with a height of 25 in. (0.6 m.) and the over-all length of 110 in. (3 m.). The driving platform folds up against the truck and allows it to be placed in an elevator somewhat shorter than its ordinary length, and the controller handle also can be raised up to save space. In case the operator leaves the

TRUCK STOPS QUICKLY WHEN PLATFORM IS RAISED

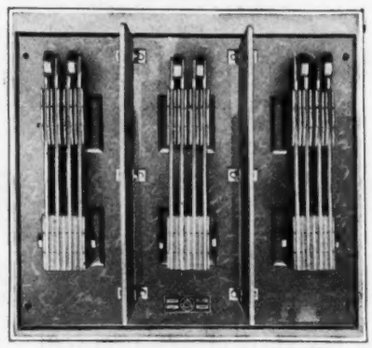
driving platform the brake is automatically applied and the controller is thrown to neutral, stopping the truck within a few inches. There are three forward and three reverse speeds to the truck with a range of 1 mile to 8 miles (1.6 km. to 12.8 km.) per hour. A battery of twenty-four Edison or twelve fifteen-plate lead cells is required. Ball bearings are provided in the wheels, and a warning horn is operated from a button on the steering lever.

Small Direct-Current Ammeters

Direct-current ammeters which may be used in automobiles, on farm-lighting plants, for garage battery-charging sets or for testing purposes are being marketed by the Ballman-Whitten Manufacturing Company, 4440 Olive Street, St. Louis, Mo., in both flush and surface types and with cases of either bright nickel or black-rubberoid finish. The scales of these meters range from 0 amp. to 30 amp. for both charge and discharge. The movements are of the permanent-magnet iron-vane type having no moving coils or fine hairsprings. All the parts are said to be of relatively large dimensions, and the working clearances are also large in order to reduce the possibility of sticking of the moving parts. The calibration of these meters throughout the whole range of the scale is close and the hysterisis effect is negligible, so that the pointer will always return to zero. Each meter has an adjusting vane, and the calibration is carefully adjusted with standards to each individual scale, according to the maker. The scales of these ammeters are of the customary etched metal style and have black letters and a black indicator with a light background in the nickel case and white letters and white indicators in the black-rubberoid finish case. These cases are of drawn brass, while the glass is held in place with a special baked cement which makes it waterproof and is further reinforced with a spring-wire locking ring.

Grouped Disconnecting Switches

Where space is limited in the installation of high-tension switches some method must be used in order to form a compact and simple arrangement. To solve this problem the Delta-Star Electric Company, 2433 Fulton Street, Chicago, has developed a unit-type disconnecting switch assembly consisting of three 4000-amp., 300-volt, single-pole,

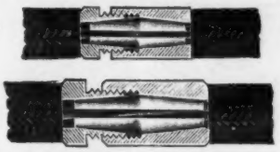


BARRIERS PREVENT SHORT-CIRCUIT OF PHASES PLACED CLOSE TOGETHER

single-throw switches mounted on a unit base with barriers between. The switches themselves are of the group type, permitting separate blade operation of each single-pole element. This insures easy opening of switches of high rating.

Solderless Connectors for Small Wires

For splicing small wires a simple and efficient solderless connector is announced by Dossert & Company, 242 West Forty-first Street, New York City. It is designated as the type D



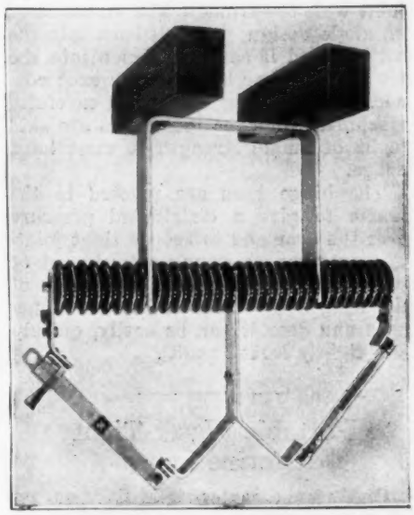
MAKES GOOD CONNECTION BY COMPRESSIVE ACTION

two-way connector and consists of male and female threaded parts acting upon a slotted tapered sleeve or bushing, making the splice by compression. These connectors are supplied in two sizes, No. 8 being for use on No. 8 and No. 9 B. & S. gage wires, and No. 14, which can be used to connect Nos. 10, 12 or 14 gage wires as desired. Their actual size is shown in the illustration.

Outdoor-Indoor Disconnecting Equipment

In developing the disconnecting equipment now being marketed by Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago, it was the designer's aim to use a minimum amount of material without sacrificing electrical or mechanical strength and at the same time to obtain an easily assembled unit. One special feature of the equipment is the use of corrugated insulators which when mounted vertically give minimum leakage under rain conditions.

The equipment designed for mounting on cross-arms is provided with one

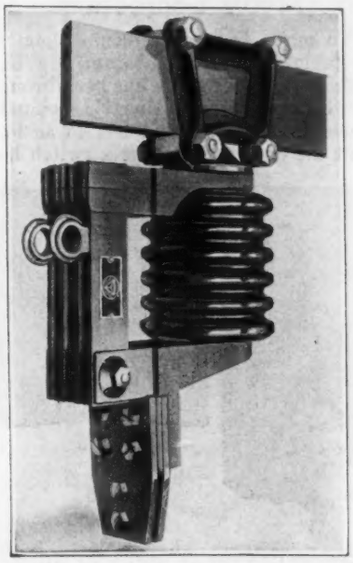


CORRUGATED INSULATORS GIVE MINIMUM LEAKAGE WHEN MOUNTED VERTICALLY

bolt. Pin stops, however, are provided to prevent side movement. Some styles of the equipment can be made to operate either above or below the cross arms by reversing the switch jaws and fuse mountings. For indoor use this allows mounting on the floor or on the ceiling. The switches are provided with die-formed guides notched to lock the blade in closed position. The hinge clip has stops which prevent the blade from moving more than 90 deg. from the closed position. These switches are furnished in the 200-amp. and 300-amp. sizes.

Disconnecting Switch for Direct Clamping on Buses

High-capacity disconnecting switches for clamping directly on buses and with contacts for tapping directly to oil-switch terminals have been developed by the Delta-Star Electric Company, 2433 Fulton Street, Chicago. According to the maker, this method of mounting saves labor, material and space as



UNIT TYPE FOR 1200 AMP., 6600 VOLTS

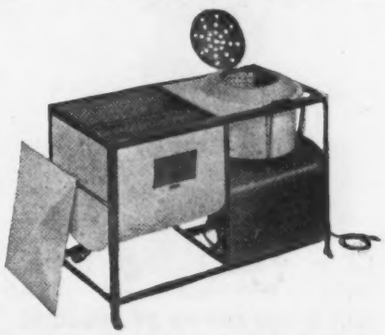
compared to the relatively heavy expense entailed when the ordinary type of switch is used. The blades are of the multiple-group type, and since they are separately operated very easy opening and closing is insured.

Adjustable Industrial Lighting Fixture

For factories, shops and other places where concentrated light is desired the Miller Saw-Trimmer Company, Point Building, Pittsburgh, Pa., is marketing the "Anyangl" lighting fixture, which consists of an upright support and a cross-arm carrying the key socket and locking lamp guard. The cross-arm may be raised or lowered on the upright rod and adjusted to any length. Because of the joint connecting the two pieces the arm can be swung to any angle, describing a complete arc in either the vertical or horizontal plane. A twist on the joint's thumb screw locks the arm and the bulb in the desired position. Three feet (90 cm.) of cord and an attachment plug are sold with the fixture, which is equipped with either a safety lamp guard or a plain reflector.

Combination Clothes Washer and Dryer

Two separate machines — a washing cylinder and a centrifugal extractor — mounted on one frame compose the Marlow electrically operated washer



CLOTHES WASHED BY REVOLVING CYLINDER AND DRIED BY CENTRIFUGAL FORCE

and dryer recently developed by the Marlow Manufacturing Company, 2152 Superior Avenue, Cleveland, Ohio. This machine, which has a twelve-sheet capacity and is suitable for large families, small hotels, hospitals and institutions, is built on commercial laundry principles. The frame is made of steel throughout, while the two tanks are of vitreous porcelain. In one of the tanks the washing cylinder of perforated brass revolves at a speed of 35 r.p.m., and in the other tank the extractor operates at 1500 r.p.m., which removes the water from the clothes in from three to five minutes and leaves them just damp enough for ironing. A ball-bearing motor is used, and the friction-drive mechanism is said to prevent shock to the driving parts and to prolong the life of the motor. This machine can be used for washing and drying separately or both at the same time. The machine is mounted on castors and little vibration is present.

Heavy-Duty Insulating Supports

Great mechanical strength, provision for proper ventilation of buses and an arrangement of conductors which will permit using a minimum amount of copper are desirable for insulating supports used on the low-voltage, three-phase alternating-current systems in vogue with large industrial companies. To meet this requirement the Electrical Engineers' Equipment Company, 710 West Madison Street, Chicago, has developed and placed on the market a line of heavy-duty supports, one of which is illustrated herewith. This unit, which is arranged for carrying four ¼-in. by 5-in. (6-mm. by 127-mm.) bars and for mounting upon two parallel 1¼-in. (31-mm.) pipes, is designed to withstand maximum short-circuit strains

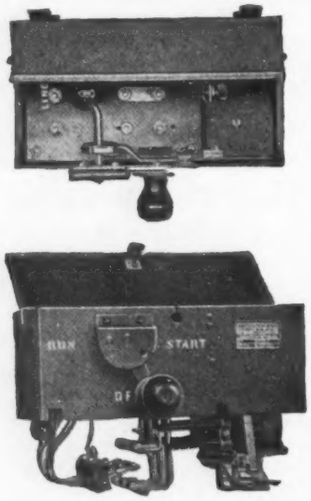
and at the same time to provide a proper factor of safety. Skin effect is reduced to a minimum by an arrangement which places the busbars in the form of a rectangle. All of the bars operate at approximately the same temperature and at the same current

SKIN EFFECT REDUCED BY ARRANGING BUSBARS IN RECTANGULAR FORM

density. This, the maker says, is an advantage over placing vertical bars side by side in the ordinary manner, since it prevents the outer bars from becoming warmer than the inner ones. Insulating spacers are supplied for inserting between the different phases.

Oil Motor Starters with Overload Coils

To start and control single-phase and polyphase induction motors and to insure electrical protection, safety to operators and continuity of service, the Condit Electrical Manufacturing Company of South Boston, Mass., is making type N-1 oil motor starters with overload release coils, for use with



TERMINAL ARRANGEMENT AT TOP AND TANK REMOVED IN BOTTOM VIEW

alternating-current motors whose full load current does not exceed 30 amp. at 600 volts or less, provided that the momentary starting current is not greater than 110 volts, 150 amp.; 220 volts, 125 amp.; 440 volts, 100 amp., and 550 volts, 80 amp.

Complete electrical protection is insured in these motor starters, it is claimed. The trip coils afford protection against overloads and short circuits, and automatic disconnection is prevented during the starting period. Upon the reëstablishing of lost voltage the motor is instantly disconnected without the customary undervoltage attachment, while an additional undervoltage attachment automatically disconnects the motor on the reduction or loss of voltage. Time limits prevent momentary surges from disconnecting the motor. A latch compels proper starting of the motor, and in addition the handle cannot be left in the starting position.

Plug Box for Temporary Motor Connections

To make temporary connections for portable motors a substantially built safety power plug box has been brought out by the Leonard Electric Company, Cleveland, Ohio. This box is so built that the door operates as a switch han-

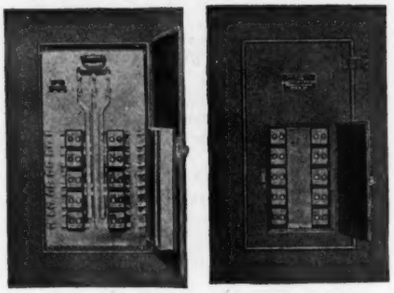
FUSES CANNOT BE REPLACED WHEN CONTACTS ARE ALIVE

dle. Opening the door breaks the circuit ahead of the fuse so that fuses cannot be replaced when they are alive. A three-point staggered receptacle is provided so that the three-point plug can be inserted only in one position, thus elimniating possibility of polarity reversal. This device may be used on three-phase three-wire, two-phase three-wire, single-phase two-wire, or two-wire direct current. When used on a two-wire system the middle fuse and connections are not utilized.

Simply Constructed Safety Lighting Panels

There are two protective doors in the safety panelboard cabinets made by the Penn Electrical & Manufacturing Company of Irwin, Pa. The large door is locked so that no unauthorized person can tamper with fuses or live parts, and only the safety operating switches are exposed when the small door is opened. When the larger door is unlocked and opened the entire panel, including busbars and fuse, is exposed so that repairs and renewals may be made with the same ease as in non-safety panels.

Each standard panelboard circuit switch used in these panels is an independent unit and can be removed from the front without interfering with the



LARGE DOOR GIVES ACCESS TO LIVE PARTS, SMALL DOOR TO DEAD ONES

rest of the panel. The slate frames are slotted for mains and branches, making installation easy. A card holder is furnished for each circuit switch so that in case of trouble on a circuit the correct switch can be operated. Large doors are equipped with special Yale locks having spring catches.

Airtight Ash-Pit Door

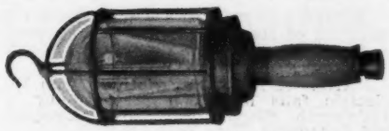
Perfectly tight ash-pit doors are essential to prevent combustion in the ash pit and also to prevent excess air from entering the boiler through some types of stokers. Recently the American Steam Conveyor Corporation, New York City and Chicago, designed and placed upon the market the "American" ash-pit door of heavy cast iron, with a heavy ventilated cast-iron liner to prevent contact with the hot ashes and consequent warping, and a machined bearing surface to make an air-tight joint with the frame. The frame is of an angle design, fits well back into the setting, and is easily fastened into the pit wall by four bolts, one in each corner. The bearing surface is carefully machined while the hinge lugs are said to be of ample strength to meet hard usage.

The hinge bars are pivoted to the frame to give a distributed pressure over the door and to keep a tight joint. The door can be swung entirely out of the operator's way, and by means of the wing nuts at the end of the hinge bars and door it can be easily, quickly and tightly locked shut.

Portable Water-Tight Marine Lamp

One of the water-tight fixtures recently brought out by the Seidler-Miner Company of 34 East Larned Street, Detroit, Mich., is a portable lamp fitted with a handle and a hook for hanging. All the metal parts are made of brass with bright or black oxidized finishes. The lamp guard, in which no solder is used, screws on the base with standard threads. A metal tube, accommodating

a large-diameter portable cable, extends through the wooden handle. The stuffing-tube cap at the end grips the cable and takes the strain instead of the socket. The screw globe which encircles the lamp is made of lead glass and is said to withstand severe temperature changes.



STUFFING-TUBE CUP RELIEVES STRAIN FROM WIRE

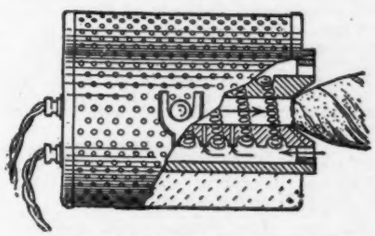
Tractor-Type Storage Batteries

A complete line of storage batteries developed especially for farm-tractor starting and ignition service has been brought out by the Electric Storage Battery Company of Philadelphia. These batteries, according to their maker, have been subjected to severe shock and vibration tests without failure, and their design is such as to withstand extreme neglect with minimum injury. The plates are of heavy and rugged design, and the separators are a combination of treated wood and perforated hard rubber, which is said to possess the good points of each. Plate groups are supported on soft-rubber bridges, offering an additional protection against shocks or vibration. Jars and covers are made of "Giant" compound, so that breakage is practically eliminated.

The elements of the battery are proportioned to fit the jars tightly, and heavy sealing nuts are used on the pillars to anchor them in place. Jars are set in compound in the carrying cases, and as an additional precaution the latter are equipped with through bolts so that the sides can be drawn together holding the jars firmly in place. Intercell connectors are of flexible copper, in order to prevent crystallization and consequent breakage under severe vibration and are lead-plated to prevent corrosion.

Electric Cigar Lighter

Lighting cigars by freshly heated air without contact is accomplished by means of the Appel electric cigar lighter, marketed by the Electric Sales Corporation, 1812 Ninth Avenue South, Seattle, Wash. The lighter comprises a perforated metal cylinder containing an electric heating element and mounted on a stand for counter attachment. Since tobacco or other foreign substances do not come in contact with the heating unit, long life is obtained, and since no flame or spark is produced outside of the lighter a high factor of safety is present, says the maker. The lighter weighs about 3 lb. (1.3 kg.) and has an energy consumption of 60 watt-hours.



CIGAR IS UNTOUCHED BY FLAME

Fuse Plug Refillable Without Tools

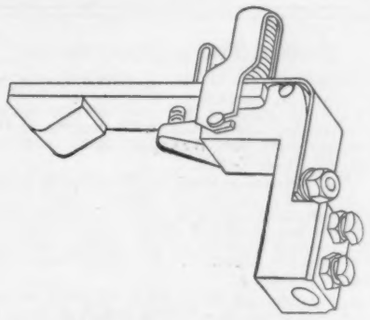
Only four parts, exclusive of the ribbon or wire fusible element, form the refillable fuse plug recently placed on the market by the Betts & Betts Corporation, 511 West Forty-second Street, New York City. These are the porcelain body, the metal cap, the threaded metal band for screwing into the socket, and the clamp contact which grips the lower end of the fuse strip and stays securely in the bottom of the plug, thus assuring positive contact with the socket. The opposite end of the fuse element makes contact with the fuse shell and is said to make a contact equal to that of a soldered terminal. No tools are required in renewing the plug, and the handling of screws, nuts and washers is eliminated. These refillable plugs may be obtained in 5-amp. to 30-amp. sizes for 125 and 250 volts.

MAY BE USED FOR SEVERAL SIZES OF FUSE WIRE

Drum Controllers with Easily Removable Fingers

The continual making and breaking of circuits in drum controllers pits the fingers, making it necessary to have them dressed frequently, which usually involves considerable time and expert effort. This dressing problem is simplified by the use of a drum controller finger now made by the Union Electric Manufacturing Company of Milwaukee, Wis., which does away with cotter pins, washers, bolts, etc. A file and sandpaper are the only tools required for dressing these fingers. The spring casing, which eliminates the use of a stud post, is released, and the finger is shown for inspection and dressing with one movement of the hand.

The finger consists of a strip of hard-drawn brass, hinged at the back and fitted into a bearing which is part of the finger base. On the opposite end is a renewable tip of cast copper held in position by two rivets. This tip can be removed by knocking off the rivet heads and inserting a new casting.



TENSION SPRING EASILY SLIPPED OFF FINGER

The fingers are held firmly against the copper cylinder segments by a steel coiled tension spring inserted in a copper-plated steel cap. Adjustment is accomplished by means of a set screw which is locked and held in place by a brass lock spring. A laminated copper strip runs from the finger bar to the base, thus making a good electrical contact. Another feature of these drum controllers is that the finger board can be removed from the drum without disturbing any other part of the controller.

NOTES ON RECENT APPLIANCES

Electric Transfer Iron

Light-weight electric transfer irons are now being made by the Berks Engineering Company, Reading, Pa.

Series Lighting Socket

Made in two pieces and equipped with a film for puncturing at a low rated voltage, the Kyle series lighting socket is being marketed by the Line Material Company of South Milwaukee, Wis.

Heater for Nitrous-Oxide Regulating Valve

To warm the nitrous-oxide regulating valves of anesthetizing apparatus the Heidbrink Company of Minneapolis, Minn., is marketing an electric warmer for lamp-socket attachment.

Farm-Lighting Plants

"Porta-Power" is the name of a farm-lighting plant made by the L. A. Young Industries, Detroit, Mich., which may be operated by an automobile instead of the customary stationary engine.

Hand-Wrought Lighting Fixtures

Chandeliers, brackets, lanterns and ceiling types are included in the line of hand-wrought iron lighting fixtures just designed by the Beardslee Chandelier Manufacturing Company, 216 South Jefferson Street, Chicago.

Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The British-Australian Machinery Company, Ltd., 50 Broad Street, New York City, desires contact with manufacturers wishing to enter and develop their trade in the Australian market. The company handles electric conduit, electric cranes and power plants.

An American firm (No. 28,763) which is establishing an office in Spain desires to secure an agency for the sale of electrical specialties and motors.

An agency is desired by a man in France (No. 28,766) for the sale of washing machines and motors. Correspondence may be in English.

A man in Italy (No. 28,771) desires to secure an agency for the sale in southern Italy of electrical machinery and supplies. Correspondence should be in Italian or French.

Maurice Broussard, who is the manager of the firm of G. Gilbert, Thouars, France, importers and utility construction engineers, is in the United States for the purpose of making arrangements to represent American manufacturers of electrical and mechanical material in France. This firm has a number of contracts to erect power plants in various places in France not now served with electricity, and it proposes to use American equipment in these places. Mr. Broussard may be reached at the Hotel Commodore, New York City.

ENGINEERING ADVERTISERS' ASSOCIATION FORMED.—Advertising and sales managers representing manufacturers in various engineering lines in and around Chicago met in that city on March 11 and organized the Engineering Advertisers' Association. The officers elected were: President, H. L. Delander, Crane Company; vice-president, H. Colin Campbell, Portland Cement Association; secretary, G. H. Eddy, Green Engineering Company; treasurer, Edward J. Pratt, Kellogg Switchboard & Supply Company. The board of directors includes: G. S. Hamilton, American Steam Conveyor Corporation; J. J. Arnsfield, Fairbanks, Morse & Company; A. P. Hauck, Allis-Chalmers Manufacturing Company; H. W. Clarke, Chicago Pneumatic Tool Company; P. A. Powers, Benjamin Electric Manufacturing Company, and J. C. Kinsley, A. M. Davis Regulator Company.

THE FEDERAL PRODUCTS CORPORATION at Providence, R. I., is the new name of the Rhode Island Electrical Instrument Company.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., announces that it has discontinued the sale of insulating joints and hickeys. All orders now in the works will be filled, but no further orders can be taken.

THE UNION ELECTRIC MANUFACTURING COMPANY, Milwaukee, Wis., announces the appointment of the P. I. Perkins Company, 141 Milk Street, Boston, Mass., as its representative in Massachusetts, Vermont, Rhode Island, New Hampshire and Maine. Mr. Blachford will be in charge of the handling of the company's line of manually operated starting and controlling equipment, both face-plate and drum types.

THE UNITED GAS IMPROVEMENT COMPANY, Philadelphia, has formed a new company called the United Gas Improvement Contracting Company, with Paul Thompson, vice-president of the parent company, as president; J. A. P. Crisfield as vice-president in charge of engineering, and D. J. Collins, vice-president in charge of sales. This company will engage in engineering, construction and sale of water-gas apparatus and gas plants, the design and erection of power plants, and, together with the sale of residuals of all kinds, will have a division to construct and maintain roads and highways under contract. It also expects to make paints. The company offices will for the present be in the United Gas Improvement Building.

THE ELECTRICAL ALLOY COMPANY, Morristown, N. J., has discontinued its office at 135 Broadway and gives its only address as Morristown.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburgh, Pa., announces the appointment of Robert T. Lozier as special representative.

THE REPUBLIC ELECTRIC COMPANY, Cleveland, Ohio, has moved its wholesale department from the downtown retail store to Eighteenth Street.

H. G. LEWIS, sales manager of the Electric Service Supplies Company, Philadelphia, has been elected vice-president of that company. He will continue his work as vice-president and sales manager.

WOODS, HUDDART & GUNN, 444 Market Street, San Francisco, Cal., have been incorporated under the name of Gunn, Carle & Company. In addition to iron and steel products the company is prepared to furnish electric furnaces, cranes, industrial trucks, plant equipment and supplies.

THOMAS CASEY has been elected vice-president in charge of general sales for the Hurley Machine Company of Chicago. Mr. Casey's career with this company has been

THOMAS CASEY

one full of inspiration and interest. Starting with it seven years ago he has progressed through the positions of stenographer, correspondent, office manager and sales manager to vice-president in charge of sales.

THE W. A. JONES FOUNDRY & MACHINE COMPANY, Chicago, Ill., manufacturer of power-transmission apparatus, special foundry and machine work, and also of the Jones spur-gear speed reducer, has opened an Eastern office at 30 Church Street, New York, under the direction of Lemuel C. Biglow, who for a number of years acted in a similar capacity with the Morse Chain Company, Ithaca, N. Y.

THE EPPING-CARPENTER PUMP COMPANY, Pittsburgh, Pa., announces the appointment of F. S. Healey as manager of sales in addition to his former office of chief engineer, vice F. F. Woods, who is now in New York City as Eastern sales manager. Albert A. Schenck of the sales department has been appointed assistant sales manager, and Paul D. Goodman, formerly of the McClary-Jemison Machinery Company, Birmingham, Ala., has been added to the sales personnel.

THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE has issued in one bulletin the statistical details of Germany's foreign trade from 1909 to 1913. These figures show the lines that are open to development by American exporters and answer the questions so frequently asked as to the classes of merchandise that can be marketed in foreign countries. The most valuable tables are those showing imports and exports with each country by articles. There are also tables showing the total imports and exports and others that show the trade by principal articles, arranged in the order of their importance. Copies can be obtained for 10 cents from the Superintendent of Documents, Washington, D. C., or any of the district or coöperative offices of the Bureau of Foreign and Domestic Commerce.

Trade Publications

DISHWASHER.—The Couch-Dean Corporation of Hartford, Conn., is distributing a folder about the "Autosan" dishwashing machines.

FANS.—A leaflet descriptive of its 1919 electric fans has been prepared by the Pittsburgh Electric Specialties Company, 396 Broadway, New York City.

CIRCUIT BREAKERS.—Industrial-type circuit breakers are the subject of bulletin No. 520 recently issued by the Roller-Smith Company of 233 Broadway, New York City.

INSULATING MATERIAL.—A booklet about the line of insulating material marketed by the T. C. White Electrical Supply Company, St. Louis, Mo., has been issued by this concern.

IRONS.—The Hotpoint Division, Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, is distributing to dealers a folder pointing out the advantages of selling Hotpoint irons.

ELECTRICAL SUPPLIES.—The Manhattan Electrical Supply Company, 17 Park Place, New York City, is distributing its catalog No. 29, whose 264 pages contain "Something Electrical for Everybody."

BATTERY-CHARGING SETS.—Individual vehicle-charging sets for lead or Edison storage batteries are illustrated and briefly described in a leaflet from the General Electric Company, Schenectady, N. Y.

FUSES.—The features of the National renewable fuse made by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago, are pointed out in a mailing folder being sent out by this company.

DOUBLE OUTLET PLUG.—How to sell three two-way plugs for $3.50 is explained to dealers in a folder distributed by the Benjamin Electric Manufacturing Company, 806 West Washington Boulevard, Chicago.

DISCONNECTING HANGERS FOR REFLECTORS.—The Thompson Electric Company, 5006 Euclid Avenue, Cleveland, Ohio, has issued booklet B-18, which is about safety disconnecting hangers for reflectors.

DISHWASHERS.—F. G. Street & Company, 60 Broadway, New York City, are distributing a leaflet which illustrates and describes four models of the "Haustetter Victor" electrically operated dishwashing machines manufactured by them.

New Incorporations

THE METROPOLITAN DETROIT ELECTRIC AUTOMOBILE COMPANY of New York, N. Y., has been chartered with a capital stock of $10,000 by L. Weiner, W. Behrens and E. E. Parrack, 66 Seamen Avenue, New York City.

THE MINE SERVICE EQUIPMENT COMPANY of Scranton, Pa., has been incorporated by Francis H. Coffin of Scranton and others. The company is capitalized at $20,000 and purposes to manufacture electrical and mechanical appliances.

THE INDIANA ELECTRIC SERVICE COMPANY of East Chicago, Ind., has been incorporated with a capital stock of $10,000 to manufacture electrical goods. The incorporators are Philip N. and John Sendak and Samuel Samuels of East Chicago.

THE MOE-BRIDGES COMPANY of Milwaukee, Wis., has been incorporated for $25,000. The president is H. Moe and the secretary-treasurer is C. A. Bridges. The company will manufacture lighting fixtures for the trade and will job glassware.

THE OWENS ELECTRIC WELDING COMPANY of Washington, D. C., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000 to manufacture welding equipment, etc. The incorporators are W. J. Dow, L. F. Sarscer and K. King Cromwell.

THE DETROIT (MICH.) ELECTRIC CAR COMPANY has been incorporated with a capital stock of $600,000 to manufacture chassis for the Anderson Electric Car Company. The plant formerly occupied by the Peter Smith Heater Company has been leased by the Detroit company. W. C. Anderson is president.

New England States

BIDDEFORD, ME.—The City Council has granted the York County Power Company permission to extend its lines on a number of streets in the city which now have not electrical service.

CLARK'S MILL, ME.—An act has been introduced in the State Legislature authorizing the Clark Power Company to construct and maintain a dam or dams on Saco River in the cities of Saco and Biddeford.

LEBANON, N. H.—The capital stock of the Grafton County Electric Light & Power Company has been increased from $200,000 to $250,000.

MILTON, N. H.—Plans are under consideration by the Farmington River Power Company for a hydroelectric plant on the Farmington River, near Windsor, to cost about $500,000. L. W. Jones of Milton is engineer.

BRANDON, VT.—The Hortonia Power Company is contemplating extending its electric transmission line to connect with the lines of the Rutland Railway, Light & Power Company at East Pittsford.

BOSTON, MASS.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 14, under Specification 3477, for furnishing six electric traveling bridge cranes, for the extension to the machine shop and foundry at Boston, Mass. The cost is estimated at $175,000.

PROVIDENCE, R. I.—The contract for the construction of the new power house and smokestack for the Revere Rubber Company at Providence has been awarded to the J. W. Bishop Company of Worcester. The cost is estimated at about $110,000.

NEW MILFORD, CONN.—The capital stock of the New Milford Electric Light Company has been increased from $100,000 to $200,000.

WILLIMANTIC, CONN.—The Hall & Bill Printing Company has purchased a site, 35 ft. by 100 ft., adjoining its property, on which it will erect a two-story addition, to be used for a new power plant and storage purposes.

Middle Atlantic States

AMSTERDAM, N. Y.—The Adirondack Electric Power Corporation is planning to place its wires in underground conduits on the principal streets of the city.

BROOKLYN, N. Y.—Plans are being prepared by H. J. Nurick, architect, 957 Broadway, for an addition to the Beth Moses Hospital, Hart Street and Stuyvesant Avenue, to cost about $350,000.

DRESDEN, N. Y.—An election will be called to vote on the proposal to install an electric lighting system. Electricity to operate the proposed system will be secured from the Taylor Chemical Works.

GOSHEN, N. Y.—Plans have been prepared by F. H. Dexter, 891 Eighth Street, Brooklyn, for alterations and improvements to the power plant of A. E. Ludlam at 144 Reade Street. The cost is estimated at about $10,000.

GOWANDA, N. Y.—Plans have been prepared for the installation of motor-driven pumping apparatus and electrical equipment at the Indian Reservation of the Gowanda State Homeopathic Hospital, to cost about $8,500; also for improvements and alterations in the power house and boiler equipment at the institution. Clarence A. Potter is medical superintendent.

NEW YORK, N. Y.—A group of factory buildings on Eleventh Avenue, from Fifty-sixth to Fifty-seventh Street, has been leased by the Chevrolet Motor Company, Broadway and Fifty-seventh Street, to be used as new motor manufacturing plant and will be operated in conjunction with the company's plant at Kingsland Point, Tarrytown. Plans have been prepared for rebuilding of the portion of the Tarrytown plant recently destroyed by fire.

PERRY, N. Y.—Preparations are being made by the Perry Electric Light Company to install a 500-kw. turbine to supplement its present power equipment. E. L. Phillips & Company, 50 Church Street, New York, N. Y., are engineers. C. W. Torrey is treasurer and superintendent.

ROCHESTER, N. Y.—The Public Service Commission has granted the Rochester Railway, Light & Power Company permission to issue $500,000 in capital stock. The cost of improvements for the electric department is estimated at $335,000 and that of the underground conduit system at $40,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

TONAWANDA, N. Y.—The J. S. Spaulding & Sons Company is considering the erection of a five-story paper mill at its plant on Wheeler Street; the cost including equipment is estimated at about $500,000.

UTICA, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 18 for conduit and wiring, lighting fixtures, etc., in the United States post office, custom house and court house at Utica.

CAMDEN, N. J.—Contract has been awarded to J. W. Geistert, 813 Newton Avenue, for electric wiring in connection with the construction of eight new garage buildings, to be erected on Byron Street.

DOVER, N. J.—The Dover Boiler Works are contemplating the installation of electric welding equipment at its local plant.

NEWARK, N. J.—Plans are under consideration by the Board of Education for the installation of a new electric lighting system throughout the Monmouth Street Public School.

PERTH AMBOY, N. J.—Plans are under consideration by the Board of Aldermen for the installation of 1400 new 600-cp. incandescent lamps and 500 lighting units of smaller candlepower. William C. Wilson is chairman of committee on lamps and lighting.

KINGSTON, PA.—Notice has been filed with the Public Service Commission by the Luzerne County Gas & Electric Company of an issue of $484,000 in bonds, part of the proceeds to be used for extensions and improvements.

PHILADELPHIA, PA.—Permit has been granted to the Philadelphia Rapid Transit Company for an addition, 22 ft. by 29 ft., to its power plant at 963 Beach Street.

CUMBERLAND, MD.—The Edison Electric Illuminating Company is completing the installation of a 5000-kw. General Electric turbine and coal-handling machinery. W. M. Roberts, Jr., is general manager.

ROANOKE, VA.—Arrangements are being made by the United States Potash & Brick Corporation, recently organized, for the construction of a new plant, to cost about $500,000. Electrically operated machinery will be used wherever possible. H. O. Spangler is president.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Account, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until April 25, East and West, Schedule 3858—miscellaneous bells and buzzers, salvo-firing buzzers. Brooklyn, N. Y., Schedule 3889—11,000 ft. of interior communication cable. Until April 11, Norfolk and Philadelphia, Schedule 3861—two turren track-turning machines, complete, with motor drive. Until April 29, Norfolk, Va., Schedule 3861—portable woodworking machine, with motor drive, complete for service. Until April 22, East, Schedule 3880—100 storage batteries, 120 volts, 140 amp.-hour. Bids will also be received in the near future for the following supplies: East and West, Schedule 3894—miscellaneous hard brass wire, hard and soft copper wire, bronze phosphor wire; East and West, Schedule 3895—miscellaneous flexible brush-holder cable, single-conductor ignition cable; Schedule 3896—miscellaneous magnet wire. Boston, Mass., Schedule 3895—500 ft. searchlight cable. Applications for proposals should designate the schedule desired by number.

North Central States

DETROIT, MICH.—General contract has been awarded by the Detroit Edison Company for the construction of a power house at Congress Street and Cass Avenue.

MARINE CITY, MICH.—The Banner Salt Company is contemplating the construction of a new power station, 50 ft. by 100 ft., one story.

AKRON, OHIO.—The Northern Ohio Traction & Light Company is contemplating the construction of a substation, to cost about $15,000.

ASHTABULA, OHIO.—The Northern Ohio Hydroelectric Company, recently incorporated with a capital stock of $300,000, is planning to construct a hydroelectric plant and three large dams in Ashtabula County to supply electricity in Ashtabula. George R. McKay, Raymond R. Oliver and others are interested in the company.

CLEVELAND, OHIO. — Arrangements have been made by the City Council for a bond issue of $800,000 to provide for extensions and improvements to the municipal electric light plant.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until April 11, for electric meters. Specifications may be obtained upon application to room 204, City Hall.

JACKSON CENTER, OHIO.—A board of trustees has been appointed by the Council to take charge of the construction of an electric lighting system. The cost is estimated at $15,000.

LORAIN, OHIO.—The Cromwell Steel Company, it is reported, will purchase new equipment for its rolling mill, including motors, generators, rolling mill machinery, etc., at a cost of about $190,000. J. C. Cromwell, Guardian Building, Cleveland, is president.

MILLERSBURG, OHIO.—The Millersburg Traction Company is planning to construct an electric railway from Millersburg to Dover.

MINERVA, OHIO.—Plans are under consideration for improvements to the municipal electric light plant. J. Sheldon, Madison and Water Streets, Toledo, is consulting engineer.

SANDUSKY, OHIO.—Work will soon begin on the new power house to be erected by the Erie Tire & Rubber Company at the old Suspension Roller Bearing Company, which will be taken over by the Erie company the latter part of this month.

BRAZIL, IND.—Arrangements are being made by the Terre Haute, Indianapolis & Eastern Traction Company for improving the electric lighting service in Brazil and vicinity. The company will erect a transmission line from the Water Street Station in Terre Haute to a point where the Clinton and Brazil high-tension lines diverge. It is also proposed to extend the high-tension line south of Terre Haute into the coal fields of Sullivan County and back through Clay City to Brazil.

GARY, IND.—The electrical department of the Gary Screw Bolt Works, was recently destroyed by fire, causing a loss of about $100,000.

LARWILL, IND.—A company has been organized to construct and operate an electric light plant in Larwill.

SEYMOUR, IND.—The erection of an electric transmission line between Southport and Seymour is under consideration by the Interstate Public Service Company to provide more electricity along the line of the Indianapolis, Columbus & Southern Traction Company. The first section, it is understood, will be built between Seymour and Columbus.

UNIONDALE, IND.—Steps have been taken by farmers near Uniondale to organize a company to supply electricity to a territory 4 miles north of Uniondale. Electricity to operate the system will be secured from the Wabash Valley Utility Company.

BLOOMINGTON, ILL.—The Bloomington & Normal Railway & Light Company is planning to extend its service to take in a large rural territory at Meadows.

CHICAGO, ILL.—Wilson & Company of Chicago, it is reported, are contemplating the construction of a new power plant in connection with their canning works to be erected at Forty-fourth Street and Western Avenue.

CHICAGO, ILL.—Work has begun on the erection of the first unit of the proposed ice-manufacturing plant to be built by the Federal Refrigerating Company, affiliated wits the Hygienic Ice Company, on a site between Halstead Street and Racine Avenue and 140th Street and 142d Street, Riverdale, Chicago. The cost of the entire plant is estimated at $1,000,000.

GILLESPIE, ILL.—Initial steps have been taken by the Southern Illinois Light & Power Company for the erection of a new power plant in Gillespie, to cost about $80,000. Electricity for the local system is now transmitted from the Hillsboro plant.

GRAFTON, ILL.—The City Council has granted Roscoe Johnson of St. Louis, Mo., president of the Grafton Clay Products Company, a franchise to install and operate an electric light plant in Grafton for a period of twenty years.

HAVANA, ILL.—Plans are under consideration by the City Council for equipping the waterworks pumping station for electrical operation. The cost of two pumping units complete with motors is estimated at $2,390.

HIGHWOOD, ILL.—The Chicago, North Shore & Milwaukee Railroad Company, it is reported, is contemplating extending its Libertyville branch to Crystal Lake.

MILTON, ILL.—The installation of an electric light plant at Milton is reported to be under consideration. Virgil Hoover is interested.

JANESVILLE, WIS.—Bids, it is understood, are being taken by the Parker Pen Company for the construction of a new three-story factory, office and power plant, to cost about $100,000. Frank A. Carpenter of Rockford, Ill., is architect.

BELGRADE, MINN.—Plans are under consideration to secure electricity for the municipal electric system and to sell the municipal generating plant. If the project is carried through it will necessitate changing from 220-volt equipment to 110-volt and rewiring all feed wires. E. A. Johnson is superintendent.

BAGLEY, IOWA.—As soon as conditions will permit work will begin on balancing up the lines of the municipal electric system, as the positive line connects with about twice as much load as the negative. The system is three-wire, 110-220 volts, direct current. The storage battery installed in the plant six years ago needs rebuilding, and this will be undertaken as soon as funds are available for the work. Preparations are being made by H. C. Fountain, manager of the municipal electric plant, for selling and installing Westinghouse electric ranges and hot plates.

APPLETON, MO.—Improvements are being made to the municipal electric light plant, including the installation of a 100-hp. Fairbanks-Morse type Y oil engine, one General Electric direct-current generator, switchboard panel, circuit breaker, ammeter, voltmeter, etc., W. B. Rollins & Company, Railway Exchange Building, Kansas City, Mo., are engineers. E. R. Wells is chief engineer.

COLUMBIA, MO.—The University of Missouri contemplates the erection of a women's dormitory, astrological observatory and home economics building, on the campus, to cost about $190,000; also to build a cattle barn and alterations to power house, to cost about $60,000. A. R. Hill is president.

KANSAS CITY, MO.—The contract for the erection of a group of buildings for the House of the Good Shepherd has been awarded to T. H. Lishear. The power house, garage, etc., will be located apart from the other buildings. The initial expenditure will be in excess of $150,000.

MARYVILLE, MO.—The Maryville Electric Light & Power Company is contemplating extending its electric system to Guilford. C. C. Hellmers is superintendent.

ST. JOSEPH, MO.—The St. Joseph Street Railway, Light, Heat & Power Company is contemplating extensive improvements to its plant and system, involving an expenditure of about $1,000,000. Most of the machinery in the power house will be replaced with new equipment. Additional pumps will be installed so that the company will not be dependent upon the city water supply. Most of the equipment, it is understood, has been purchased. J. H. Van Brunt is general manager.

BISMARCK, N. D.—The Capitol Street Railway Company is planning to extend its street railway to the Minneapolis, St. Paul & Sault Ste. Marie Railroad and to the Capitol grounds.

LAKOTA, N. D.—Contracts, it is reported, will soon be awarded by the city for two concrete wells, two motor-driven pumps, two pump houses, an electric transmission line, a 50,000-gal. tank, heating system for elevated tank, two 3-in. motors, laying cast-iron pipe, hydrants, etc.

MADISON, S. D.—An election will soon be called to vote on the proposal to issue $125,000 in bonds for the construction of a new electric light plant in Madison.

OSWEGO, KAN.—An election will be held April 1 to vote on the proposal to issue $50,000 in bonds for the installation of a municipal electric light plant. A. C. Moore of Joplin, Mo., is engineer.

SHARON SPRINGS, KAN.—The City Council is considering calling an election to submit the proposal to issue $40,000 in bonds for improvements to the municipal electric light plant and waterworks system. The proposed work includes the erection of new power house, one 150-hp. and one 100-hp. engine, improvements to distribution system, a 75,000-gal. tower and tank, etc.

UNIONTOWN, KAN.—The question of establishing a municipal electric light plant in Uniontown is under consideration.

Southern States

BURLINGTON, N. C.—The Mutual Power & Light Company, recently incorporated, is contemplating the installation of a central power plant to furnish electricity to various cotton mills and industrial plants. The company is capitalized at $125,000. Eugene Holt, L. B. Williamson and others are interested.

TROUTMANS, N. C.—The Troutmans Light & Power Company, recently organized, is planning to transmit electricity from Barium Springs to Troutmans for light and power purposes. J. B. Waugh is secretary and treasurer.

ALBANY, GA.—The Georgia-Alabama Power Company is contemplating a 10,000-hp. development on Flint River near Albany, to cost about $2,000,000. Mees & Mees of Charlotte, N. C., are engineers.

MIAMI BEACH, FLA.—The Miami Beach Electric Company, recently incorporated with a capital stock of $250,000, proposes to construct and operate an electric light plant and ice factory in Miami Beach. A. C. Newby and others are interested in the company.

PENSACOLA, FLA.—Surveys have been completed and plans submitted to the County Commissioners for the construction of an electric railway from Pensacola to Flomaton, Ala., a distance of about 40 miles. Herbert A. Smith, of Gonzalez, Fla., is interested in the project.

SARASOTA, FLA.—Bonds to the amount of $80,000 have been voted for the installation of an electric light plant.

NEW ORLEANS, LA.—At the convention held recently at Bay St. Louis, Miss., an executive committee was appointed to make arrangements for the construction of a municipally owned electric interurban railway to connect New Orleans, La., and Mobile, Ala., with all the Mississippi coast towns. John J. Kennedy of Biloxi, Miss., is chairman of the committee.

COALFIELD, TENN.—The power house of the Coalfield Coal Company was recently destroyed by fire, causing a loss of about $15,000.

RIPLEY, TENN.—An election will be called about May 1 to vote on the proposal to issue $150,000 in bonds to construct lighting, water and sewerage systems.

BLYTHEVILLE, ARK.—Arrangements are being made by the Missouri Southeastern Utilities Company to erect a power plant to supply electricity in Blytheville, Marmaduke, Paragould, Ark., Caruthersville, Hati, Greenway, Rector and Kenneet, Mo. The plant may be located in Blytheville.

HELENA, ARK.—The Helena Gas & Electric Company is reported to be considering the construction of a new electric plant in the near future.

LITTLE ROCK, ARK.—The capital stock of the Arkansas Hydro-Electric Development Company has been increased from $50,000 to $500,000.

MONROE, LA.—Municipal improvements are contemplated by the city of Monroe, involving an expenditure of more than $1,000,000, which will include enlargements of the waterworks system, additions to the municipal electric light and power plant and extensions to the municipal street railway system.

ADA, OKLA.—The Oklahoma Power & Transmission Company, it is reported, is contemplating extending its electric transmission system to Davis and Sulphur.

BLANCHARD, OKLA. — Arrangements have been made by the City Council for a preliminary survey of the town for the purpose of securing an estimate of the cost of installing a municipal electric light and water plant.

CHICKASHA, OKLA.—The Chickasha Peanut Oil & Products Company, recently organized, is planning to install pressing machinery, power plant, equipment, etc. D. C. Hybarger is president.

MARIETTA, OKLA.—Bonds to the amount of $15,000 have been issued for improvements to the electric light plant and waterworks system.

MIAMI, OKLA.—Preparations are being made by the Southwestern Light & Power Transport Company, Commerce Building, for a water-power development on Grand River, northeastern Oklahoma, to include seven dams (15,000 hp. each). The company also plans to build an auxiliary plant of 10,000 hp. capacity in Miami, which will hold the peak load in case of low water or flood. The company, it is understood, will need a 10,000-hp. turbine within sixty days. W. T. Croslen is president and chief engineer.

PAWHUSKA, OKLA.—The City Council is considering issuing $250,000 in bonds for improvements to the municipal electric light plant and water and sewerage systems.

RENFREW, OKLA.—The local electric light plant was recently destroyed by fire.

TAHLEQUAH, OKLA.—The City Council is considering calling an election to submit the proposal to issue $65,000 in bonds for the construction of a new electric light plant.

TULSA, OKLA.—Surveys have been completed by the Oklahoma Union Railway Company for an electric railway from Keifer to Okmulgee, via Mounds and Beggs. The company also contemplates the construction of a railway from Tulsa northward to Nowata, via Collinsville.

EL PASO, TEX.—Plans will be prepared by the city engineer for improvements to the Scenic Drive. The installation of arc lamps, etc., is the first work contemplated.

Pacific and Mountain States

SEATTLE, WASH.—Bids will be received by the Board of Public Works until April 9 for furnishing the various city departments with approximately 400,000 incandescent lamps.

PORTLAND, ORE.—The Portland & Oregon City Railway Company is contemplating the construction of a car line from Oregon City through the timber belt, 18 miles in length.

ATWATER, CAL.—Preliminary plans are being prepared by the Fruitland Drainage District of Atwater for the installation of a series of electrically operated pumping plants for irrigation purposes.

BAKERSFIELD, CAL. — Arrangements are being made by the San Joaquin Light & Power Corporation to extend its electric transmission lines to provide service for 200 additional pumping plants in Kern County. The company has 700 applications for electrical service in the valley. D. L. Wishon is local manager.

HANFORD, CAL.—The California Packing Corporation, 101 California Street, San Francisco, is contemplating the construction of a factory and power house and a number of cottages in Hanford. P. Bush, 101 California Street, San Francisco, is architect.

INDEPENDENCE, CAL.—The Board of Public Service has entered into a contract with the Big Pine Water Users' Association of Inyo County whereby the city of Los Angeles acquires sites for three power plants and two reservoir sites. Construction will not be undertaken for some time. W. Mullholland of Los Angeles is chief engineer.

RIVERSIDE, CAL.—The Southern Sierras Power Company is installing additional equipment at its plant at Inyo canyon, including one 2200-hp. Pelton turbine, one 1500-kva. Westinghouse generator with switchboard equipment, and three 1000-kva. Westinghouse outdoor type transformers. C. O. Poole, chief engineer, is in charge of the work.

BRIGHAM, UTAH. — Bonds to the amount of $15,000 have been voted for extensions and improvements to electric distribution system, including new street lighting equipment.

BAKER, MONT.—The Baker Light & Power Company is contemplating improvements to its system, including the installation of one 3-kw. and one 5-kw., 2300-110-220-volt transformer. Material for overhead line work will include fifty three-wire racks, one barrel of 2200-volt insulators and 5000 ft. No. 8 weatherproof wire; also ten 5-amp. and five 10-amp. meters. Ernest G. Heinrich, owner, is in charge of the work.

KALISPELL, MONT.—The City Council has awarded contract for lighting thirty special improvement districts in the city to the Mountain States Power Company. Resolutions creating three new special lighting districts have been passed and contracts let for electric lamps not included in the lighting districts.

WIBAUX, MONT.—The Eastern Montana Light & Power Company is contemplating extensions and improvements to its local plant and also to its systems in Glendive, Mont., and Beach, N. D.

PAGOSA SPRINGS, COL.—The electric plant of the Moore Electric Light & Power Company of Pagosa Springs has been purchased by Hersch, Catchpole & Shields. The new owners, it is understood, will make improvements to the plant, including the installation of new machinery.

Canada

VIKING, ALTA.—The installation of an electric lighting system is under consideration by the Town Council. W. McAthey is clerk.

WINNIPEG, MAN.—Bids will be received by the Department of Public Works, Ottawa, Ont., until April 16 for construction of an extension, 110 ft. by 122 ft., to power house and laundry at the military hospital, Tuxedo. The cost is estimated at $75,000. R. C. Wright, care Department of Public Works, is architect.

TORONTO, ONT.—A by-law authorizing an expenditure of $200,000 for the installation of an electric light and power system will be submitted to the ratepayers. W. A. Clark, 40 Jarvis Street, Toronto, is clerk.

LAKE EDWARDS, QUE.—Plans are being prepared by the Department of Public Works, Ottawa, Ont., for the construction of a power house at the military hospital. R. C. Wright is architect.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, A. H. Krom. 29 South La Salle St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West Fortieth St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Annual meeting, New York City, April 3-5.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. University of Pennsylvania, Philadelphia, Pa.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Fort Smith, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Stone & Webster, Boston, Mass.

ASSOCIATION OF MUNICIPAL ELECTRICAL ENGINEERS OF ONTARIO. Secretary R. A. Clement, 190 University Ave., Toronto, Ont., Can. Annual convention, Niagara Falls, Ont., June.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & North Western Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St. East, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 110 West 40th St., New York City. Annual meeting, White Sulphur Springs, May 1-3.

COMMERCIAL SECTION, N. E. L. A. Secretary, Henry Harris, Pittsburgh, Pa.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, Shiras Morris, Hart & Hegeman, Hartford, Conn.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill. Annual meeting, Hot Springs, Va., June.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRIC POWER CLUB, Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

ELECTRIC VEHICLE SECTION OF THE N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

Directory of Electrical Associations

Printed in the First Issue of Each Month

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Annual meeting, Chicago.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

JOVIAN ORDER. Jupiter (president), J. F. Strickland, Dallas, Tex.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Detroit Edison Co., Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, H. C. Hoffman, St. Paul Gas Light Co., St. Paul, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary-treasurer, L. D. Gordon, Jackson Light & Traction Co., Jackson, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 721 Locust St., St. Louis, Mo.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass. Annual meeting, Springfield, Mass., Oct. 13 and 14.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York City. Annual convention, Atlantic City, N. J., May 19.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, R. W. McGinnis, O'Neil Light & Creamery Co., O'Neil, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass. Annual meeting, Boston, Mass., June.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Affiliated with N. E. L. A. Secretary, George L. Myers, Pacific Power & Light Co., Portland, Ore.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, 618 Mission St., San Francisco, Cal. Annual meeting, San Diego, Cal., April 30-May 2.

PENNSYLVANIA ELECTRIC ASSOCIATION. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 152 Beach St., Yonkers, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, O. J. Gronsdahl, Hartford, S. D.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, T. W. Peters, Columbus, Ga.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex. Annual meeting, Galveston, Tex., May 12-14.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Greenwood, S. C., April.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis.

Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 25, 1919)

1,295,500. FAUCET; Louis R. Hibbard, Los Angeles, Cal. App. filed July 2, 1917. Has controlling valve, by which cold, warm or hot water is delivered.

1,295,501. BOILER ALARM; John J. Hines, Halifax, N. S., Canada. App. filed Aug. 27, 1917. For marine use.

1,295,502. COMBINED FIRE-ALARM AND WATCHMAN'S SERVICE SIGNAL SYSTEM; Albert W. Hitchcock, Hinsdale, Ill. App. filed July 26, 1916. Code signaling mechanism in signal boxes readily switched from fire-alarm circuit to watchman's circuit.

1,295,509. HEATING DEVICE; Frank C. Ingalls, Newark, N. J. App. filed June 28, 1916. Inserted in intake line of internal-combustion engines using gaseous fuel.

1,295,528. IGNITION SYSTEM; George L. Lang, Newark, N. J. App. filed Dec. 27, 1915. Sparks obtained regardless of slow engine speed.

1,295,548. ELECTRICALLY OPERATED MUSICAL INSTRUMENT; Alcide H. Maitre and Victor H. G. Martin, Rouen, France. App. filed March 27, 1914. Auxiliary excitation used for initial quivering of strings completely suppressed when amplitude of vibration of vibrant member becomes sufficient to be self-exciting.

1,295,553. SIGNAL-CORRECTING SYSTEM; Robert C. Mathes, New York, N. Y. App. filed Aug. 14, 1918. Corrects for wandering zero and makes possible accurate reception of cable signals.

1,295,563. ELECTRIC FIXTURE SWITCH; Harry J. Morey, Syracuse, N. Y. App. filed March 7, 1916. Readily wired from front of ordinary outlet box and serves as cover therefor.

1,295,567. PORTABLE ELECTRIC LAMP; David A. Murphy, Portland, Ore. App. filed April 6, 1918. Displays different lights, colored as desired, and has chamber for holding extra light bulbs.

1,295,570. WELDING ELECTRODE; Thomas E. Murray, New York, N. Y. App. filed Dec. 4, 1918. Has cavity for receiving elongate object to be welded.

1,295,572. APPARATUS FOR CAUSING A PREDETERMINED VARIATION OR PREDETERMINED VARIATIONS IN A PHYSICAL EFFECT; Ralph W. Newcomb, Greenwich, Conn. App. filed Feb. 23, 1918. For electromagnetically controlling heat, light, sound or electrical apparatus.

1,295,588. LAMP-SOCKET SWITCH; Roscoe C. Peleager, Philadelphia, Pa. App. filed June 1, 1917. For use in candelabra.

1,295,599. ELECTRIC GONG SUPPORT; Henry E. Reeve, Brooklyn, N. Y. App. filed July 14, 1917. Inconspicuous in use, unbreakable and easily handled and transported.

1,295,613. ELECTRIC MOTOR OR DYNAMO; William R. Scott, Norwich, Eng. App. filed May 20, 1915. Conductors effectually fill armature slots wider at top than at bottom.

1,295,633. IMPULSE STARTING COUPLING; Henry Tiedeman, Newark, N. J. App. filed July 15, 1918. For internal-combustion engines.

1,295,643. RUBBER-TIRE-REPAIR VULCANIZER; Sidney Le F. Varvel, Sydney, N. S. W., Australia. App. filed Sept. 7, 1917. Electrically heated vulcanizing plate supplied with current from low-voltage storage battery.

1,295,646. TELEGRAPH SOUNDER; Sylvester Voorhies, Enderlin, N. D. App. filed Oct. 15, 1917. Operates directly in main line without use of local battery.

1,295,660. STORAGE-BATTERY SEPARATOR; Theodore A. Willard, Cleveland, Ohio. App. filed May 5, 1917. Formed of rubber and has ribs not easily broken off.

1,295,691. ART OF AND APPARATUS FOR GENERATING AND DISTRIBUTING MUSIC ELECTRICALLY; Thaddeus Cahill, New York, N. Y. App. filed Feb. 17, 1904. Subscribers' instruments supplied with musical electrical vibrations from single central-station instrument.

1,295,709. CIRCUIT-CONTROLLING SWITCH; Robert M. de Vignier, Hollis, N. Y. App. filed July 16, 1918. Controls large number of independent circuits.

1,295,714. PROTECTOR; Joseph F. Ebert, New York, N. Y. App. filed April 18, 1916. Powdered mica and talc insulating material used in lightning protection.

1,295,752. APPARATUS FOR THE ELECTRIC DISSOLUTION AND PRECIPITATION OF METALS; Edward R. Holden, Los Angeles, Cal. App. filed April 17, 1917. Plurality of currents of different emf. are distributed simultaneously in different parts of an electrolyte.

1,295,777. ELECTRIC CIRCUIT CLOSER; Earl M. McGrath, Helena, Mont. App. filed Jan. 8, 1918. Causes current to flow through devices either in series, in parallel or in multiple groups.

1,295,783. DIRECTION INDICATOR; Willard M. Mathews, New Bedford, Mass. App. filed Oct. 2, 1915. Operable from seat of driver to indicate at both ends of vehicle the direction to be taken.

1,295,787. ELECTRIC WELDING MACHINE; Thomas E. Murray and Harry R. Woodrow, New York, N. Y. App. filed Sept. 23, 1918. Effective means for cooling parts of transformer.

1,295,797. TELEGRAPHY TYPEWRITER; Harry O. Rugh, Chicago, Ill. App. filed Dec. 11, 1914. Single circuit needed between point of control and point where printing takes place.

1,295,816. TESTING APPARATUS FOR FOUR-WIRE REPEATER CIRCUITS; John F. Toomey, New York, N. Y. App. filed Oct. 16, 1917. Transmission may take place through repeater station when repeater has been disconnected for testing purposes.

1,295,823. DIMMER; Jesse C. Osborn, Benton, Harbor, Mich. App. filed Dec. 11, 1917. Moving core into magnetic field decreases voltage delivered to lamps.

(Issued March 4, 1919)

1,295,852. HOOD AND ELECTRIC LIGHT SUPPORT; George W. Cassidy, New York, N. Y. App. filed March 15, 1918. Also constitutes wire-way for electric circuit.

1,295,853. ELECTRICAL MEASURING INSTRUMENT; Lewis W. Chubb, Pittsburgh, Pa. App. filed Aug. 10, 1916. For measuring distortion factors of alternating-current waves.

1,295,854. DISTRIBUTING SYSTEM FOR ELECTRIC RAILWAYS; Almon W. Copley, Wilkinsburg, Pa. App. filed Dec. 14, 1915. Series transformers interlinking trolley conductor with feeder conductor.

1,295,857. PROCESS OF TREATING ZINC ORES; Augustus P. Craft, Galena, Ill. App. filed June 23, 1917. Lime, iron pyrites and other impurities easily removed.

1,295,860. BRUSH HOLDER; John S. Dean, Wilkinsburg, Pa. App. filed Jan. 4, 1916. Flexible conductor prevented from coming into accidental contact with holder body.

1,295,877. STATION INDICATOR; George H. Egbert, Evansville, Ind. App. filed June 8, 1918. Constitutes reversible double reel and web marked with names of stations or streets.

1,295,885. RELAY SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed March 4, 1915. Operates to suppress ground or open circuit when circuit becomes grounded.

1,295,886. DISTRIBUTING SYSTEM FOR ELECTRIC RAILWAY; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed June 5, 1916. Minimizes inductive disturbances from adjacent circuits.

1,295,887. SYSTEM OF DISTRIBUTION; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 7, 1918. Disturbances from distributing system substantially neutralized.

1,295,894. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed March 1, 1917. Accelerating or regenerative operation of main machine or machines accomplished without use of resistors.

1,295,906. SPEED CONTROL FOR INDUCTION MOTORS; Benjamin G. Lamme, Pittsburgh, Pa. App. filed Jan. 5, 1915. Speed regulated by returning energy to supply circuit through frequency converter.

1,295,909. TELEPHONE-EXCHANGE SYSTEM; Eric R. Lundius, Brooklyn, N. Y. App. filed May 11, 1918. Disagreeable clicks in receiver of answering operator prevented.

1,295,912. CIRCUIT CONTROLLER; Ray H. Manson, Rochester, N. Y. App. filed May 18, 1914. Push-button easily operated at any point.

1,295,913. PUSH-BUTTON SWITCH; Ray H. Manson, Elyria, Ohio. App. filed May 18, 1914. For signal warning apparatus of vehicles.

1,295,914. CIRCUIT CONTROLLER; Ray H. Manson, Rochester, N. Y. App. filed May 18, 1914. Button of large area causes actuation of warning signal device, no matter where touched.

1,295,915. CONTROL APPARATUS AND SYSTEM; Paul L. Mardis, Altoona, Pa. App. filed May 3, 1915. To govern operation of fluid-actuated drum controller for plurality of railway motors.

1,295,921. PARALLEL-FLOW REACTANCE COIL; John F. Peters, Edgewood Park, Pa. App. filed Sept. 10, 1914. Comprises plurality of spaced copper strands connected in multiple.

1,295,930. CONTROL SYSTEM; Samuel B. Schenck, Wilkinsburg, Pa. App. filed May 3, 1915. For four-motor equipments commonly employed on railway cars.

1,295,933. DISTRIBUTING SYSTEM FOR ELECTRIC RAILWAYS; Charles F. Scott, New Haven, Conn. App. filed March 8, 1917. Minimizes inductive disturbances.

1,295,950. AUTOMOBILE WARNING DEVICE; Bruno Zabel, Edgewood Borough, Pa. App. filed Sept. 5, 1916. Bell rung when unauthorized person releases brake.

1,295,966. SWITCH MOVEMENT; Samuel Buchsbaum, Chicago, Ill. App. filed July 21, 1917. Contains but two moving parts exclusive of finger piece which operates them.

1,295,995. TERMINAL BOX; Martin Luther, Chicago, Ill. App. filed May 16, 1917. Covering for open face of outlet box utilized as terminal chamber for conductors.

1,295,998. TELEGRAPH PRINTER; Benjamin F. Merritt, East Orange, N. J. App. filed May 11, 1918. Comprises rigid frame to which printing magnet and its armature are attached.

1,296,000. FLOAT-OPERATED SWITCH; James G. Michael, Windber, Pa. App. filed May 15, 1918. Works in connection with starter or in direct connection with motor, none of the parts, except switch blade and contact, being "alive."

1,296,006. SPARK ENERGIZER; Abraham Press, Washington, D. C. App. filed June 11, 1917. Will not deteriorate and keeps adjustment at all times relative to spark plug gap.

1,296,015. CONTROL SYSTEM; Karl A. Simmon, Edgewood Park, Pa. App. filed March 9, 1917. Inductive coil connected to field windings of motors by one switch.

1,296,104. SEMI-AUTOMATIC TELEPHONE SYSTEM; Harry W. Munsell, Indianapolis, Ind. App. filed Sept. 25, 1915. Only necessary to operate one key to call any subscriber in the exchange.

1,296,126. SPARK-PLUG ATTACHMENT; Guy M. Sherrill, Eastland, Tex. App. filed June 15, 1918. Renders plug useful even after porcelain is badly cracked.

1,296,136. SPEED-CONTROL SYSTEM FOR INDUCTION MOTORS; Wilfred Sykes, Pittsburgh, Pa. App. filed Oct. 24, 1916. Flexible in operation and substantially free from surging.

1,296,142. TELEGRAPH-SOUNDER CIRCUITS; Sylvester Voorhies, Enderlin, N. D. App. filed March 11, 1918. Has two windings, one energized from local and other from main-line circuit.

1,296,175. RELATING TO THE TESTING OF INSULATION; Sydney Evershed, Chiswick, London, Eng. App. filed March 21, 1914. Instrument measures resistance and resistance difference.

1,296,176. RELATING TO THE TESTING OF INSULATION; Sydney Evershed, Chiswick, London, Eng. App. filed March 21, 1914. Portable apparatus for determining any significant part of characteristic curve of electrical insulation.

1,296,177. AËRIAL FOR WIRELESS SIGNALING; Charles S. Franklin, London, Eng. App. filed Nov. 27, 1915. Has maximum value in one direction only.

1,296,188. PROCESS FOR MAKING ANODES OF SOLID MANGANESE PEROXIDE; Max Huth, Berlin-Charlottenburg, Germany. App. filed Nov. 3, 1914. Hardening and increasing the density and conductivity of the anodes is accomplished.